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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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A Different Kind of Conference

A FAVORITE American sport is the holding of conferences. We are constantly seeking subjects for desultory discussion by large groups. So often do such conferences prove fruitless, except to gratify the ambition of the limelight seekers, that as result-producers they are generally discredited. Consequently when the President announced the Unemployment Conference there were many who expected a meeting of the standard rambling, unproductive variety. Happily, they have been disappointed. The conference was composed of people having contact with the subject from a variety of angles. Upon convening if found ready all the necessary machinery—stenographers, clerks, statistical experts, etc.—for efficient functioning. In addition—and what is far more important—it found prepared for its consideration a large amount of well co-ordinated statistical data, summaries of conditions in previous unemployment periods, and suggestions for relief—all of which had been collected in advance by an advisory committee of statisticians and economists. The conferees, therefore, had something to work on, material stimulative of thought and discussion, yet of a kind that helps to hold the considerations down to the thesis of the meeting. This excellent organization and preparation, for which credit must be given to the inspiration of Mr. Hoover and the intelligent work of his able lieutenants, is without doubt responsible for the brass-tack character of the suggestions for emergency relief. The conference certainly was "different," which, however, is just what the country has learned to expect from Herbert Hoover.

Ignorance About Construction Costs

REFERENCE is made in the comment on the Unemployment Conference to the favorable price situation. How necessary it is to bring this to the attention of public officials is shown by the recent action of a board of county commissioners. Steps were taken some months ago to get under way the work of replacing an old bridge, an improvement which public men and organizations of the county describe as urgently needed. Legal questions blocked progress at the time and nothing has been done. Now, when the commissioners are urged to resume the work, it is stated that they are disposed to postpone the improvement for a year or two in the hope of getting much lower prices. Apparently these officials are blind to what is happening in the construction field. It is apparent that engineers or their societies can do much in the present circumstances to set public officials straight on the price situation. No one is in a position to guarantee the future costs, but the indications in present bids and the prospect of stabilization of material prices warrant the recommendation that necessary work be proceeded with at once.

Campaigns Win Wars

WARS are not won by single battles; campaigns are the agents of victory—which is only another way of saying that "keeping at it brings success." The Unemployment Conference—or the part of it concerned with emergency measures—has been held. It has sent out its recommendations. It is the first national battle against unemployment, but if it is the only battle, the war against unemployment is lost. There must be a campaign, a constant drive until the winter's peak is over. There must be hammering until every community organizes efficiently, and then new and continual hammering to insure the vigorous prosecution of the relief work. Every reader of *Engineering News-Record* has a duty as a citizen to help in the hammering, and to function on the working committees. In fact, he has a duty greater than that of any other class of citizen, for it is his industry, chiefly, which is looked to for relief. His societies, engineering as well as contracting, need to get on the firing line and by their expert advice to aid their communities to get the present strong picture of attractive prices and construction opportunities. Every community council or committee will welcome the expert aid of engineers and contractors collectively and individually. The societies should at once appoint committees and have them get busy.

Highway Safety and a Railroad Analogy

A THROUGH-TRUSS highway bridge was knocked down last week by an automobile truck which ran into one of the trusses and destroyed some of the web members. Almost at the same moment a train out in Indiana knocked down a railroad bridge in precisely the same way, wrecking two spans. The coincidence points at a new condition that has been developing almost unnoticed. Modern road traffic brings with it risks of accident not much different from those affecting railways and this is true on the road itself as well as on bridges, though the present case calls specific attention to the latter. The fact is that our highway system, with the traffic it carries, is quite similar to a railway track network carrying high-speed trains—but one over which the trains runs at the pleasure of the enginemen, without control by block signals, interlocking derails or the other safeguards that have been introduced into railway practice. This uncontrolled operation is already seen to be unsafe, and we think is sure to prove more unsafe as traffic grows. The railroad analogy of the particular highway bridge accident reported is particularly apparent. In that accident a truck and a passenger car were trying to pass in the single-way width of the Little Patuxent crossing of the main Washington-Baltimore road, although warning signs at the bridge approaches told that the bridge was too narrow for vehicles to pass; they collided and were thrown against the truss members,

wrecking them and bringing the bridge down. Thus the accident is directly chargeable to the fact that the drivers ignored warning signs, just as neglect of signals by enginemen has caused many a railway wreck. The experience gained in railway service can find very useful application in the development of our highway transportation systm. Whether or not mechanical safeguards at dangerous crossings, junctions, and passing points are needed or are practicable is not now the question; if the danger points are recognized and the nature and seriousness of the risks which they involve come to be understood, the discovery of the most suitable means for protection will follow.

Collision Resistance in Bridges

THERE are more perplexing questions in the Little Patuxent bridge accident than appear on the surface. If highway engineers are content to build their bridges so light that a swerving motor truck can knock them down—or if cost limitations compel them to build this way—the situation is serious. For some years past progressive highway departments have recognized the desirability of making bridge railings and balustrades strong enough to resist the impact of vehicles that might run against them, and several states now regularly build hand rails of this robust type even where there is a roadway curb and a sidewalk. All the reasons that argue for such construction apply with multiplied force to protection for the web system of a through-truss bridge. Few existing truss bridges are of such heavy construction that the web members would survive the impact of a colliding truck; and, of course, destruction of either a post or a diagonal is practically certain to wreck the whole structure. Not many such accidents have occurred hitherto, fortunately, but this in itself is not very reassuring, in view of the continuous expansion of fast motor-truck traffic that seems to be in sight. The Little Patuxent wreck raises the question very directly whether it should not be made standard practice to build through-truss highway bridges strong enough to resist truck collision, or whether, if this is not practicable, fender curbs should be provided as a protection.

Railway System Consolidations

AN OUTSTANDING event in engineering interest last week was Prof. Ripley's report on the consolidation of the railway systems of the country. Such a study, under the auspices of the Interstate Commerce Commission, was a necessary precedent to the consolidation action looked for in the Transportation Act. Necessarily, Prof. Ripley's plan is but the start of hearings and discussions in which its merits and demerits will undoubtedly be adequately handled. Out of that, then, should flow the framework, at least, of the consolidated systems which, all students of the question generally agree, must come. Only by absorption of the weaker lines into stronger systems can the transportation industry of the country be put into a healthy condition. The National Association of Owners of Railroads Securities is also having consolidations studied by its Board of Economics and Engineering, which is now at work. It will have a viewpoint that should be well worth considering. The operating officials, too, will have views so that we many shortly expect a thorough airing of the entire subject.

Overemphasizing the Corps of Engineers

A COMPLETE reading of the arguments on the proposed Department of Public Works, which in condensed but comprehensive abstract appear on another page, confirms a growing impression that the status of the Corps of Engineers and its control of the river and harbor work is playing much too large a part in the campaign for a revision of the engineering functions of the government. Most of the arguments in the Engineer Department circular are palpably background for the defense of the Corps of Engineers, which would maintain its status quo, admitted by its own members to be unsatisfactory in many ways, for fear of its complete disintegration under a Department of Public Works. On the other hand, the A.A.E. arguments, while apparently more sincere, concentrate on the antagonism to the Corps as an institution and register confirmed opposition to any scheme which does not relegate the Corps to the position of a subordinate military unit.

This is decided overemphasis of only one phase of an important and many-sided question. The overlapping of government engineering activities is manifestly inefficient and expensive and their proper co-ordination a step toward the reduction of the cost of government. If, however, the legislators at Washington, who must order the reorganization, get it into their heads that this is merely a military-civilian fight inside the engineering profession, they will wash their hands of the whole affair. Fair-minded advocates of the Public Works Department idea will do well to recognize this situation.

The Corps of Engineers' stand is quite explainable. In all published schemes for the new department the Corps is relieved of its present important civilian duties and thrust into a nebulous state, where part of the time its members are subordinates of civilians and part of the time subordinates of line officers. Its natural opposition would be partly relieved or the cause partly removed if the advocates of the new department freely admitted that war is a possibility, that military engineers are something more than civilian engineers in uniform and that responsible charge of large works is a necessary peace-time preparation for responsibility in war. At the same time the Corps might as well recognize that the day of military aristocracy is passing and that the horizontal demarcation between the civilian engineers and the army officers in the Engineer Department can not long be tolerated. The position of the United States Assistant Engineers is in large part responsible for the feeling among engineers against the Corps. It is un-American that there should be any branch of our government in which competent, trained men should be barred from promotion by the existence of officials of life tenure or where such men should automatically be in subordination to men of lesser age, training and capacity. Such a system, with all its implications, goes against the American grain. Some way must be found whereby the civilian engineer is made something more than the perpetual and enforced subordinate.

Meanwhile the Public Works Department idea must not be killed by the elevation of what really is a minor controversy to the position of a critical issue. Sooner or later some rational scheme will be proposed whereby the Corps of Engineers can get proper and equal train-

ing in both military engineering and civilian responsibility and at the same time will not be given autocratic control of an important government civilian activity. Such a scheme has yet been put forward and until it is no lasting harm would be done by the establishment of a Public Works Department, embracing all the other engineering functions of the government and leaving for the future the solution of the Corps of Engineers' tangle.

Price Situation Justifies Unemployment Conference Recommendations

IT WAS not to be expected that the Unemployment Conference would produce a panacea or even novel ideas. The problem is too old to bring forth much of novelty. What the conference has done is to awaken the country to a sense of the seriousness of the problem, to make a dramatic mobilization of all sound means for increasing employment and to mark the inception of educational propaganda to get each community to put to work every agency that can have an influence on the situation. Fortunately, too, the price situation places a stamp of approval on the major recommendations of the conference.

The salient feature of the recommendations is that they relate to means of *increasing employment* and not to measures for charitable relief. The soundness of that method of solution need not be emphasized. Equally self-commendatory is the principle laid down that each community should organize within itself to handle the situation. The responsibility for functioning is put on the mayors, and the governors are appealed to to unite and activate such state agencies as can aid the efforts of the mayors' organizations.

Our own field, that of construction, offers, in the judgment of the conference, the largest area for increased employment, a statement indisputably correct. There are plentiful signs, too, of increasing construction activity and for that there is a very excellent basis. Prices have come down and though they are still 80 per cent above what they were in 1913, as shown by *Engineering News-Record's* construction-cost index number, there are indications that contracts will be taken much lower.

In both Iowa and Minnesota bids were submitted last week for earth work on road jobs at 22 cents per cubic yard, which is down to pre-war prices and as low as it is good to have work go; below that figure is loss, inefficiency, and defaulted contracts. In steel, two recent lettings tell a significant story. At Pittsburgh a steel arch bridge has been let on a bid just over $100 per ton, including the fabrication and rather difficult erection over a river. In New York the steel framework of the Federal Reserve Bank Building has been let at about $70, erected. These prices are so near the lowest obtainable in pre-war years as to be startling, especially when it is considered that wages in many trades are still high and that freight and various miscellaneous costs remain abnormal. It is apparent, therefore, that some contractors feel that prices will go lower and are bidding lower than today's quotations in some cases warrant.

There are, also, indications that material price stabilization is at hand. Steel sheets have gone up, so has brick, and lumber prices are generally conceded to be too low.

Taking these various facts into consideration, it is safe to say that, compared to the war peak, we are in bargain days for construction work. The facts quoted are an unanswerable argument for getting underway every bit of necessary private and public construction work. The Unemployment Conference's recommendations, therefore, on construction are fully justified by the facts. It is "up to" every engineer and contractor to bring these facts home hard to the mayor and the unemployment committee of his city.

This is the time to go ahead with needed work. The prices warrant it, the unemployment situation demands it.

New York's Transit Situation

IN COMMON with all other municipalities, New York has had its transit troubles. Even before the war came to make them particularly acute, its surface lines had fallen on evil days. With the advent of war the entire system, including the elevated and underground lines, felt the stress. As a consequence there has been continuous discussion for the last four years, the companies pleading for relief, the municipal authorities standing fast for the maintenance of the five-cent fare. Withal it is generally recognized that only by a courageous procedure can the situation be righted.

Acting under mandate from the state legislature, the Transit Commission has recently rendered a preliminary report which will have interest for all concerned with municipal activities. It provides that all physical properties be taken over by the municipality upon a fair valuation, and that the companies be paid in bonds. The stock of the present companies would be wiped out. The operating companies would be given a lease, and out of the revenues would be paid the operating expenses, a 5 per cent interest return on the bonds, with an additional 1 per cent set aside to amortize the securities, while the bonds would be further secured by provision in the contract for the maintenance of a rate of fare automatically determined to meet at all times the cost of operation, bond interest, and the 1 per cent for amortization.

In addition to this an incentive to efficient and economical management would be offered in the form of an additional 1½ per cent on the face value of the bonds. Control of the properties would be in the hands of a board of control of seven members, three to be appointed by the operating companies, three by the city, and the seventh to be selected by the other six.

While the plan is tentative and open for discussion between the interested parties, it is plain that the largest city in the country is tending toward a basis in which the municipality will have a larger direct connection with the operation of its transit facilities, a direction in which other cities have already shown the lead. The sum and substance of the significance to municipal engineers is that in these transit rearrangements the municipal engineer is bound more and more to be drawn into the questions rising out of the operation of transit facilities.

The discussion and disposition of the New York plan, therefore, will be of much interest to readers of *Engineering News-Record.*

Minnesota Swamp Land Reclaimed for Farm Use

Company Drains Land, Makes Soil Studies and Lays Out Roads and Farms—Ditch and Tile Drainage—Rainfall Record—Large Ditching Machines Work on Soft Ground

By Merlin H. Dappert
Drainage Engineer, Albert Lea, Minn.

A LAND drainage, reclamation and settlement project of exceptional interest which is now being carried out in Minnesota is that of the Albert Lea Farms Co., near Albert Lea, Minn., this 15,000-acre project including not only ditch and tile drainage of swamp land, but also roads, bridges, wells, farm buildings and farming operations. In addition to the engineering and agricultural work, soil and hydraulic investigations and crop studies are being made on this tract by the University of Minnesota, as the results are applicable to large areas of wet and swamp land in that part of the state.

About fifteen years ago a drainage district was organized in Freeborn and Mower counties for the purpose of draining Rice Lake, Mud Lake and Sargossa Lake and the swamp land surrounding them. As the estimated cost of reclamation exceeded the existing value of the land, much opposition was encountered, with the result that only a main outlet ditch and nine lateral ditches were constructed, at a total cost of approximately $170,000. The excavation of these first ditches caused a remarkable change in the character of lands. Lakes were converted into marsh lands, and marsh lands into good hay and pasture land. But the landowners, limited by meager capital and not fully realizing the possibilities of complete drainage by the addition of smaller open ditches and tile systems, were satisfied to use the land for pasture, occasionally cutting hay from the marsh lands.

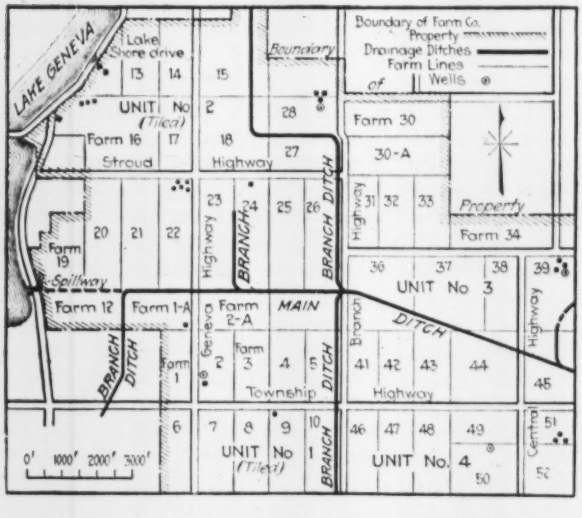


FIG. 1. PORTION OF ALBERT LEA FARMS AND DRAINAGE PROJECT

Within the center of the drainage area of 90,000 acres was the Barber Marsh, a basin comprising 15,000 acres of land which would be very productive if thorough drainage was accomplished. In 1918, the Payne Investment Co., Omaha, Neb., made an exhaustive examination of this marsh to determine the possibilities of reclamation. Borings were made and soil samples taken and analyzed. Surveys were made to determine the engineering problems of drainage. Other investigations included market facilities, transportation, agricultural requirements and probable cost of reclamation. The feasibility of the project being established, the Albert Lea Farms Co. was organized to purchase and develop the land, under the supervision and management of the Payne Investment Co. The climate is favorable for the raising of small grains, corn, hay and truck, as the counties mentioned are in the southern part of the state, and climatic conditions are similar to those of northern Iowa.

Rainfall records show an average annual precipitation of 27 in., distributed as follows: Winter, 2.71 in.; spring, 6.89 in.; summer, 10.94 in.; autumn, 6.48 in., December being considered as the first month of winter. As to rainfall intensities, records for 29 years show only one rain of 2.2 in. within one hour, two storms of 2 in. in one hour, and 15 storms where between 1 in. and 2 in. of rain fell in one hour. The maximum rainfall for a six-day period is 9.4 in. In several storms 7 in. of rainfall has occurred in a two-day period.

The topography is such as to facilitate drainage, there being a fall of from 2 to 4 ft. per mile from the edges of the marsh to its center. In the direction of the main outlet, the fall is 5 ft. per mile in the upper marsh area, flat through the central portion and 2 ft. per mile below the marsh area. The main ditch is 18 miles long, commencing at the east side of Lake Geneva and running southeast to Turtle Creek at a point three miles above its junction with the Cedar River. This ditch has a fall of 19.4 ft. or a little more than 1 ft. per mile. The total fall from the head of the ditch to the Cedar River is 32 ft. in a distance of 21 miles. Lake Geneva bounds the west side of the tract, acting as a storage reservoir for a watershed of 20,000 acres of rolling land lying west of the lake.

Uplands 5 to 60 ft. higher than the basin surround the marsh area. In these uplands, the divides are well marked; the valleys are wet and need outlets for tile drainage. In the basin area, the soil varies from muck, well decomposed peat and peat-loam to clay loam, 2 to 16 ft. deep, underlaid by sand, silt, clay-loam, and clay sub-soil. The upland soil varies from a black loam underlaid by clay to a more clayey soil, not so rich in fertility as the lower lands. Only several hundred acres of timber existed on the tract. Most of this has been divided into wood-lots and is being preserved for future use.

Prior to development, the tract was sparsely settled and almost inaccessible. The few existing roads were little better than trails, being impassable during the wetter seasons. Interior development was commenced in the spring of 1919, about 300 acres of land being seeded. During the summer and fall 15 miles of small open ditches were dug and 2,500 acres of land were plowed, ready for cropping in 1920. The old system of open ditches has greatly deteriorated from lack of

maintenance. Willows and cotton-woods have grown upon the spoil banks and sides of the ditches. Fence crossings, fords for cattle and carelessly constructed openings through the spoil banks, have caused the formation of bars, resulting in a filling of from 2 to 4 ft. by sedimentation.

Soon after work on the project was commenced, steps were taken to organize a drainage district to permit of cleaning out all existing ditches and extending them where necessary to reach sub-areas. The organization of Judicial Ditch No. 4, Freeborn and Mower counties, has been completed and the ditch established in court proceedings. Some modifications of plans are now being made, and the district work will be advertised and contracts awarded in the near future. Approximately 36 miles of open ditches with base widths of from 8 to 50 ft. will be constructed. Besides the open ditch work, there will be seven miles of tile drains, a large spillway and many surface water inlets and catch basins.

Capacities of the ditches are being made large enough to care for 50% more than the quantities of run-off obtained by the Elliot formula: $q = \frac{20}{\sqrt{M}} + 3.63$, in which q equals second feet per square mile and M equals area in square miles, which latter was considered applicable to the upper Mississippi Valley for absorptive and easily drained soils. In determining velocities and capacities on open ditch work, values of the co-efficient of roughness used with the Kutter formula are being taken as $n = 0.0225$ to 0.030. The normal low water flow will be from 3 to 5 ft. below tile outlets. High-water flow will be 2 ft. below natural surface in the lowest area (the bed of old Rice Lake), and from 2 to 5 ft. below the natural surface of the balance of marsh land making up most of the site.

Culverts through spoil banks are a special feature, these culverts being of corrugated pipes with concrete protection, inlets or catch basins and flap valves. No openings will be left in the spoil banks for admission of surface water. The estimated cost of the drainage district work approximates $263,000. On account of

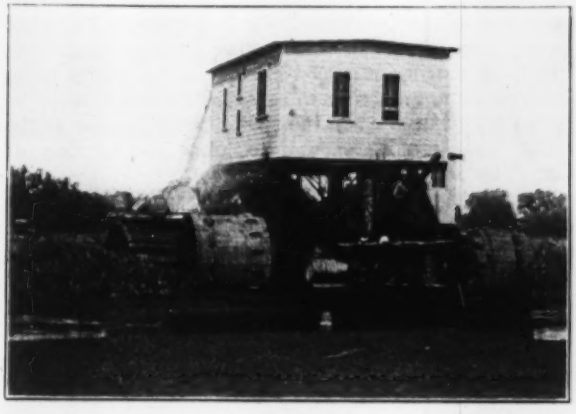


FIG. 3. EXCAVATOR CROSSING OLD CREEK BED

numerous delays in the organization and establishment of this drainage district, the Albert Lea Farms Co. decided to go ahead with the work of interior development rather than to wait for the cleaning of the open ditches.

In this interior development the general plan of procedure is as follows: The tract has been subdivided into eight units of from 1,000 to 3,000 acres each. Roads are laid out and the units subdivided into farms of from 40 to 240 acres, each farm being given a number. Most of the farms comprise 80 to 120 acres of land. A typical portion of the layout of four units is shown in Fig. 1. Topographical maps with 1-ft. contour intervals are prepared for each unit prior to drainage, and soil surveys are made as soon as the surface ditching has been completed. The importance of topographical and soil surveys, not only for drainage plans, but for planning location of building sites and size and division of the farms, cannot be too strongly emphasized. The soil survey was made only in a general way on the first work, but is now being made very carefully. For draining a unit, the first step is the construction of small open ditches to remove the surface water. A 90-ton, 120 hp. ditching and roadbuilding machine used for this purpose is mounted on two wheels and two continuous bearing crawlers, the width of bearing being increased by heavy planks bolted to the crawlers and the wheel rims. This machine is shown in Figs. 2 and 3. A revolving wheel cuts the ditch to its finished shape, and a conveyor belt carries the material 20 ft. from the line of ditch, depositing it in a single spoil bank. The ditches are 12 ft. wide on top and 6 ft. deep with a rounded base, the excavation running about 1½ cu.yd. per lin.ft. With one crew of five men, a ½-mile run is an average for a 10-hr. day. Where roads are to be built, a ditch 7 ft. deep is dug and the spoil bank is cut down by tractors with road graders, as

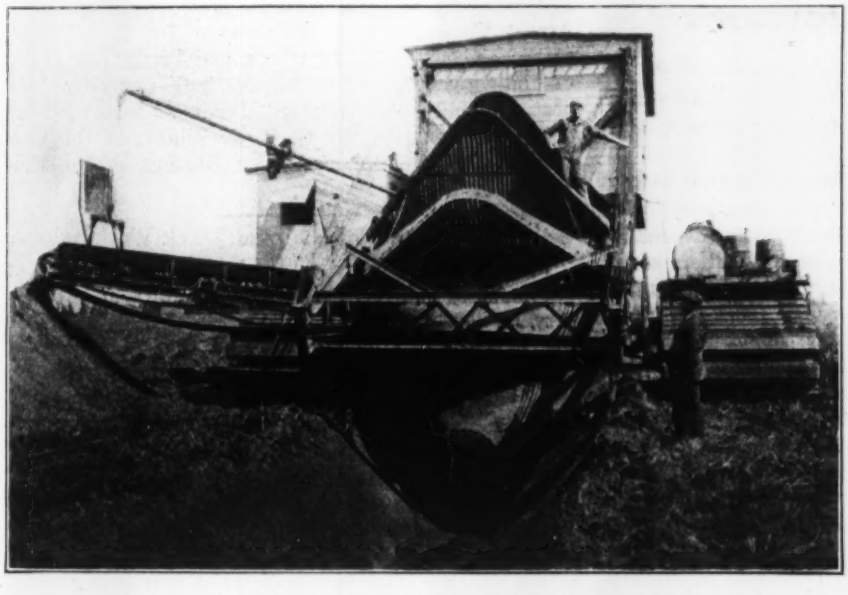


FIG. 2. WHEEL EXCAVATOR CUTTING DRAINAGE DITCHES 12x6 FT.

shown in Fig. 4. Where the soil is not heavy enough for road-building purposes, clay is hauled in and used as topping. As soon as this roadbed becomes compacted, a heavy surfacing of gravel is applied, the gravel being obtained from numerous hillocks in the marsh area.

Tile drains are laid in the open ditches as soon as the water table recedes enough to allow the hauling of tile. The sides of the ditches are then thrown in to cover the tile, this work being done with a blade or grader machine drawn by a tractor, as in Fig. 4. A wide, shallow depression, such as can be readily crossed in farming, is left over the main tile drain to carry off surface water in early spring when snow is melting

FIG. 4. TRACTOR AND GRADER MAKING ROADBED AND FILLING TILED DITCH

and ground is frozen (see *Engineering News-Record*, July 7, 1921, p. 28).

After the main drains have been laid, sub-mains and laterals are added to complete the drainage. The spacing of laterals varies from 80 to 300 ft., depending upon conditions, lateral tiles being omitted where sandy subsoil allows complete drainage with only main tile drains. Capacities of tile drains vary from ½ to ¾ in. Laterals are laid from 3.5 to 4.5 ft. deep. The question of laying lateral tile 5 ft. deep in the more peaty soils is being considered, and experiments are being made to determine the effect of deeper drainage. Both concrete and red clay tile are used, a thorough test for presence of alkaline salts in soil and drain water having shown it to be perfectly safe to use concrete tile.

Drainage is followed closely by farming operations, 15 tractors, 130 horses and from 90 to 150 men being used for this work. Several complete sets of modern farm buildings have been constructed. Sites are selected for future use, and more farm buildings will be built next year. Artesian wells are being driven on many of the farms, a good flow of water being secured at a depth of 120 ft. Temporary bridges built where new roads cross dredge ditches will be replaced with steel structures when the work of dredging is completed.

Of this 15,000-acre tract, 4,000 acres have been thoroughly tiled and tiling is progressing on another 2,000 acres. Nearly 6,000 acres are in cultivation and 3,000 acres more are in the first stages of development. Approximately 6,000 acres will be left for reclamation in 1922 and 1923. Of 15 miles of roads constructed, 11 miles are now gravelled. Over 100 miles of tile drains have been laid.

The principal crops being raised are flax, buckwheat, oats, barley, rye, corn, sudan grass, clover, timothy, sugar beets, potatoes and various kinds of truck. On account of the immense amount of hand-labor required for sugar beets and truck, only small acreages have been planted to these crops. Yields have been very good, considering that the land is new. The first crop of flax on 2,000 acres averaged 13 bushels to the acre. Last year the yields per acre from different fields were as high as follows: oats, 68 bu.; flax, 20 bu.; potatoes, 264 bu.; and sugar beets, 17 tons.

Experiments with many varieties of seed, with and without fertilization, are being conducted by the University of Minnesota, which has also established a substation for drainage investigation. A thorough study of groundwater conditions, run-off and spacing of laterals is being made. In May, 1921, the thoroughness of the drainage system was proved when 7.38 in. of rain fell during the month, 6.08 in. falling within a period of 12 days and 2 in. in two hours. Not an acre of crop was injured where tiling was completed, and the tile drains were of adequate capacity to meet all requirements for rapid removal of excess water.

This development work is under the supervision of Geo. H. Payne, president of the Payne Investment Co., and T. F. Stroud, of Omaha, Neb. R. F. Payne is general manager. J. W. Dappert, Taylorville, Ill., who has been the consulting engineer, has recently been appointed engineer for the drainage district. The drainage of the tract is under the supervision of the writer. Among the agricultural advisors are Dr. T. J. Alway, of the University of Minnesota, and Prof. Ezra Levin, of the University of Michigan, both experienced in peat and muck soil farming. Drainage investigations are being conducted by G. R. B. Elliott, of the University of Minnesota, and Sven Norling, of the University of Upsala, Sweden.

Unit Costs of Railroad Track Work

In studying to carry on track maintenance work at minimum cost in relation to effective work, it is necessary to have uniform records of cost units. Further the records must be published so that each railroad or division may know what the items of work cost on other roads and divisions. These views were expressed in an address before the Roadmasters and Maintenance of Way Association at Chicago, by Charles A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry. His remarks are abstracted below:

One of the first things necessary is to agree on a classification of the different portions of a railroad. The cost of laying rail on a track having 20 trains over it in working hours will be much in excess of the cost on a piece of road having but 10 trains. The cost of inserting ties will vary with the class of ballast, and between ties put in without raising the track and those put in while lifting the track out of face for a new lift of ballast. Track work in large yards and on passing tracks and side tracks should be shown separately. Classes of ballast should be made, so that work on unballasted track and on lines having similar classes of ballast could be compared.

A few of the important items might be listed to start with and others added from time to time. For instance, the cost per mile for relaying rail, divided to show the cost of the different items of work, including surfacing the new rail, unloading the new material and loading the old material. Labor force is allowed usually on the basis of so many men to the mile of main line, regardless of sidings and turnouts. Some roads have a method of track equation by which track is equalized as to different classes of work that take extra labor. All roads should do this in order to distribute forces equally.

New Machine Completes Tunnel in One Operation

Shield Carries Cutter Head—Rotating Tail Ring Sets Lining Blocks and Advances Shield

A TUNNEL shield, with a boring head and a rotating tail attachment by means of which the lining is placed, is operating successfully in an experimental tunnel in Philadelphia, Pa. In this tunnel, which is through schist and has a 5-ft. bore, the machine has advanced at the rate of 5½ ft. per hour. Eight men operated the outfit. This is the only measure of performance which is now available, but it is expected that the machine will soon be installed on actual tunnel work for the city of Philadelphia when more comprehensive records will be secured.

FIG. 1. COMPLETED LINING BEHIND MACHINE

In its combination of a boring head, a protecting shield and a rotating tail-cam or helix for placing the lining and advancing the shield, the machine illustrated differs from other tunneling machines.

As indicated by Fig. 3, one motor drives the boring head and the rotating helix. The head is so arranged that its center may be moved up and down or right and left by means of a lever actuating eccentric cams connected with the movable teeth at the ends of the revolving arms. This makes it possible to change the line or grade of the tunnel. Four adjustable external fins at the quarter points of the shield also aid in changing its alignment.

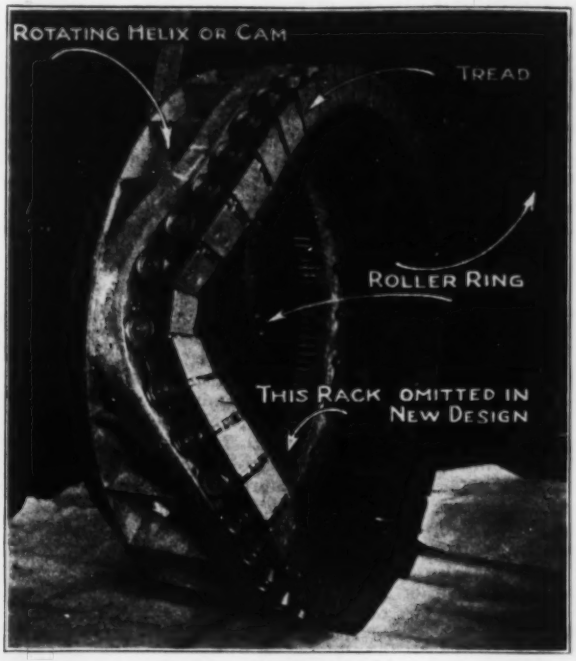


FIG. 2. ROTATING HELIX, CRAWLER TREAD AND ROLLER RING

The rotating helix ring is installed inside the tail of the shield and bears against a roller ring set between a rib in the shell and a rib on the helix. On the front edge of the helix is a rack by which the gear train effects its rotation. On the rear edge rides a crawler ring whose feet bear against the edge of the lining in place. The helix ring, roller ring and crawler tread are shown by Fig. 2.

As the helix rotates it produces in the caterpillar tread an advancing gap for inserting the concrete lining blocks one at a time around the bore. The blocks are set in spiral courses so that as the helix revolves it forces the shield ahead by screw action. The same thrusting action closes up the lining joints and expands the lining ring to fill the space occupied by the shell of the shield. This expansion is aided by the shape of the blocks.

Several hundred feet of experimental tunnel have been constructed without trouble. An inside view, after the lining had been plastered, is presented by Fig. 1. Observation of the machine in operation indicated an unusually orderly and simple procedure even in the restricted space of a 5-ft. bore. The machine was invent-

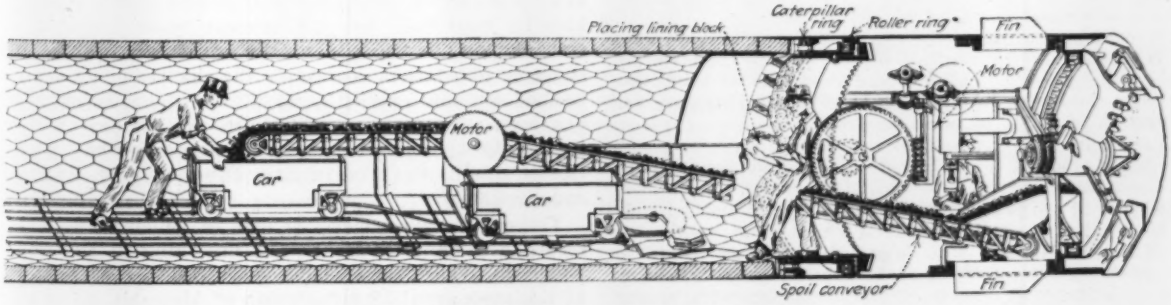


FIG. 3. TUNNELING MACHINE IN OPERATION

ed and patented by M. Roy and Earl Shean, of Philadelphia. Raymond Thomas, electrical engineer, Arthur M. Barnes, mechanical engineer, and A. Sanford Craven, civil engineer, were engaged in the final development. We are indebted to these gentlemen of the Tunnel Machine Manufacturing and Engineering Co. for information and an opportunity to study the machine in operation.

Selection of Pipe for Water-Works

By J. W. Ledoux
Consulting Engineer, Philadelphia, Penn.

Abstract of a paper before the New England Water Works Association, September, 1921.

FOR water-works pipe 24 in. in diameter and above and under pressures of more than 50 lb., a consideration of the various materials available is advisable. Some designers consider cast-iron pipe so far superior to other kinds as to leave no room for argument. In a large part of the United States, especially in the districts yielding hard [alkaline rather than acid] waters, where the soil conditions are favorable, this position could not be seriously criticised because the initial leakage should be immaterial, the cost of maintenance nominal, the lasting quality indefinite, and cast-iron pipe can be obtained readily in the competitive market throughout the East and Middle West. For the soft waters of New England and other states, the mountain regions and the colored waters of the Atlantic Coast, cast-iron supply mains will lose a large part of their carrying capacity within a very few years. Instances of small sizes losing 60 and large sizes 30 per cent of their original capacity within twenty years are common. It is true the pipe can be cleaned and the original discharging capacity restored, but sometimes within a year after cleaning, the results are as bad as before.

Coatings or paints for cast-iron pipe have all been tried without permanent success. Cement lining is expensive and materially reduces the discharging capacity. Cement lining is best when applied to wrought-iron or steel pipe, as has been proved by over thirty years' experience. The only difficulties were with the joints, the tapping and the competition with cast-iron pipe. But this kind of pipe became discredited due to certain pipe contractors, who tried to reduce the cost by cheap workmanship, and the use of lean mortar.

For low head and large sizes reinforced-concrete is practical and successful, particularly since good and economical expansion joints have been designed. For high heads it will in all probability be necessary to use a thin sheet steel tube within the reinforced concrete. Some firms are now ready to furnish, install and guarantee this class of pipe for almost any conditions and pressure. It has the great advantage that it can be fabricated complete in large quantities at or near the site of the installation, which is impracticable with any form of metal pipe.

Wood pipe has for many years been exploited and used as a substitute for wrought-iron pipe. Where the material, design and construction have been good and the conditions suitable these pipe installations have been satisfactory for pressures below 150 lb. per square inch.

[The author next described the various types of wood-stave pipe—sectional and continuous—and pointed out some of the factors governing their satisfactory use. A considerable part of the paper related to the leaks in and satisfactory repairs of the sectional, machine-bound wood-stave pipe line at Norfolk, Va., described at greater length in *Engineering News-Record*, Sept. 8, p. 396. An article by Mr. Ledoux giving detailed cost estimates for cast-iron and wood-stave pipe for a pumping main, taking carrying capacities into account, appeared in *Engineering News-Record*, Nov. 11, 1920, p. 932—Editor.]

Discussion—A variety of opinions as to the pressure wood-stave pipe will stand were expressed. Allen Hazen declared that under very heavy pressure wood-pipe is sure to leak.

Some Dams of the Ancients

Earliest Masonry Dams Had Base Four Times the Height, But With Improved Methods the Romans Reduced This Ratio to Three to One

By Charles Prelini
Civil Engineer, New York City

DAMS are probably the least known structures of past ages. All that is generally known of them comes to us because they have been mentioned by some historian, or slightly hinted at in the reports of different explorers. Unfortunately the explorers have never paid much attention to engineering structures as such, and in most instances only the length and height of the dams have been recorded, and not the base. Consequently we are unable to determine any rule followed by the ancients in the design of these interesting structures.

One of the most ancient dams on record is the Marduk dam erected across the river Tigris to regulate the waters of that troublesome river. Built in prehistoric times it survived the Chaldean, Assyrian, Persian, Greek, Roman, and Sassian dominations, and it was breached and fell in ruins at the time of the Mongol invasion towards the end of the 13th or the beginning of the 14th century of our era. This magnificent dam, according to a description found in a clay tablet, was built by Marduk (the Nimrod of the Bible), and was recorded in the following manner:

Flowing wide like a sea was the river, when Eridu was made, when E-Sagil was built:

E-Sagil in the midst of the fresh water deep, where the God of the glorious abode dwells.

Marduk laid reeds in the face of the waters:

He piled up the earth banks sheltered by the reeds; that he might cause the Gods to swell in the place of their heart's desire.

To this day the immense barrage across the ancient bed of the Tigris above Opis is called Marduk dam, which fully confirms the description of the clay tablet. The reeds mentioned as part of the construction of the earth embankment, probably were not simple reeds, but strong and resistent timbers laid in the "face of the waters" to arrest their course, and consequently a kind of cofferdam protecting the construction of the embankment. The fact that this timber work was erected to facilitate the construction of the embankment is clearly indicated in the clay tablet with the words: "He (Marduk) piled up the earth banks sheltered by the reeds." Marduk may have left this timber work within the embankment to consolidate the structure to give a stronger foundation, decreasing the chances of its being washed out and carried away during the freshets. It has been a common practice with the nations of antiquity to consolidate even the masonry walls with timber works, as found in Asia Minor, Greece, France and Scotland.

The most ancient masonry dam of which we have a record was built by Menes, the first king of the first Egyptian dynasty, over 4,000 years B. C. It was built at Kosheish about 12 miles south of Memphis, to intercept the course of the Nile river so as to lead it into a canal, diverting the river from the locality where Menes built the city of Memphis. It was built of cut stone masonry, as recorded by Herodotus and attested by its ruins, which are still in existence. We do not know the dimensions of this important structure but

from the width and depth of the river and height of the banks and annual inundations, it must have been no less than 1,500 ft. long and 50 ft. high. The dam built by king Menes was kept in perfect condition under the Egyptians, Persians, Greeks and Roman rulers or for a period of more than 45 centuries, but it was neglected and ruined during the Caliph's domination, when the lower part of the city of Memphis was flooded again by the periodical inundations, and most of the ancient monuments were destroyed, or buried in the muddy deposits of the river.

Largest Dam in Arabia

The largest masonry dam ever built in the world was erected in connection with the irrigation works in Yemen, Arabia. Only a few explorers have visited the ruins of this interesting structure, and unfortunately they were not technical men. Some of these explorers, however, have given the height and base of the dam, which enables us to learn something concerning the rule followed by the ancient engineers in designing such construction. Lokman, king of the Sabeans about the year 1700 B. C., built a very large reservoir for irrigation and water-supply purposes. This was formed by intercepting with a very large masonry dam the course of the Wadi Shibwan at a point about 6 miles from the city of Saba. The dam was 2 miles long, 120 ft. high and 500 ft. wide at the base. It lasted for nearly 2,000 years, collapsing at the beginning of the 3rd century of our era, causing a disastrous flood, which is still recorded in the Arabian literature. Before the total collapse, the dam must have given some indications of its dangerous condition, since Arabian history mentions the fact that the owners of the irrigated lands, some time before the disaster, sold their properties and emigrated. The immensity of this dam can be deducted from the enormous amount of stone masonry required in its construction, estimated at not less than 15 million cu.yd. The proportion of base to height of the Saba dam was 4 to 1.

Maspero claims that the great fertility of the Fayoum in Egypt was not due to the existence of the famous Lake Moeris as described by historians and geographers of the antiquity, but to numerous artificial lakes formed by impounding the waters of the different ravines that entered the Fayoum. In support of his theory he mentions a dam across the Wadi Gezzaweh discovered by Dr. Schweinfurt in 1885. The learned archeologist has not given all the necessary dimensions of this important engineering structure, but he says the ravine is about 240 ft. wide and the banks 40 and 50 ft. high. The dam is 143 ft. wide at the base and was formed of three different materials. The lower portion is composed of irregular stones of not large size embedded in clay; the next layer is formed of irregular limestone blocks piled up as is our riprap work and the upper portion of the dam is composed of cut stones laid in horizontal courses and forming a series of steps, the upper course always receding from the one below it. The central part of this structure was carried away by the force of the torrent, but close to the abutments the original structure is still standing for almost one-fourth of its width. In the absence of the height of the dam, which is not given, we may suppose that it was somewhat lower than the banks and consequently it must have been about 36 ft. high. Comparing the base with the height these are in the exact proportion of 4 to 1.

The Romans built many dams, some of which have entirely disappeared, while the ruins of others are still in existence. Yet no one has investigated the dimensions and methods of construction of these important structures. The only thing we know is that they were composed of massive masonry of great resistance and longevity. The one built by Emperor Nero at Subiaco lasted 13 centuries, as attested by a document recording the data of its collapse. A study of the Roman dams could be made by an inspection of the ruins of those built in the African provinces in connection with irrigation. The Romans certainly built dams which were watertight, and were strongly built of regular cut stones laid in lime mortar, and probably they reduced the thickness of the base of the dam to three times the height. Such a practice must have been continued all through the Middle Ages, since we find the early Elche dam in Spain, built by Moors in the year 913 under the reign of Abderraman III, was 52 ft. high and 159 ft. thick at the base; that is, a base three times the height.

Cross Sections Not Known

If we lack information about the dimensions of the dams built by the ancients, we know less concerning the cross sections of these structures. Considering, however, that the masonry dams were the successors of the embankments, they must have been constructed with the main characteristic features of the former structures. A masonry dam was probably designed with a level top, and the front and back faces sloping in the opposite directions, resulting in what we call today a trapezoidal profile. The sloping faces were not formed with an even surface but in a series of steps of small height as seen in the Egyptian dams, a feature which has been preserved for many centuries, since it was used also by the Moors in the middle section of the Almanza dam. Most of the ancient reservoirs were deprived of spillways, the series of steps on the downstream face of the dam greatly facilitated the fall of water overflowing from the top during the freshets. The steps prevented the water from acquiring great velocity, which would have been disastrous to the structure, undermining its foundations. The different materials employed in the construction of the Wadi Gezzaweh dam were probably laid with different slopes, thus giving a profile composed of lines of various inclinations, after the manner used by the French engineers in designing dams.

It would be very important to know what kind of binding material was employed to connect the stones in the construction of the ancient dams. Clay, asphalt and lime mortars have been employed by the nations of antiquity in the construction of walls. In Egypt, lime mortar was used since pre-historic times, while in Chaldea, as far as we know, it was employed only at the time of King Nebuchadnezzar. Such a fact may lead to the discovery whether the Atheim and Dyalek dams were really built at the time of the great improvement on the Tigris River, or are of more recent construction, replacing those previously built which were destroyed. It will also indicate if the Saba dam was built either by Egyptians or Chaldean engineers and consequently indirectly prove the rule detected in the design of the ancient structures, whether it was the practice of only one country, or a general rule followed by all the engineers of antiquity to make the base four times the height.

City Surveys of Rivers and Harbor at Milwaukee

Triangulation on River Channels to Establish Dock Lines—Hydrographic Work in Lake—Organization and Equipment—Field Work and Mapping

A RECENT triangulation survey of the harbor and waterways of the city of Milwaukee, covering approximately 23 miles of dock frontage or 11½ miles of rivers and canals, has been made for the purpose of definitely establishing dock lines, correctly mapping the existing water front and providing a base for future surveys for harbor and water-front improvements. The harbor includes a natural outer harbor on Lake Michigan, protected on the north and south by large points of land, and an inland harbor composed of rivers and canals which afford dockage and transportation facilities for industries. In 1874 the City Council established dock lines along the Milwaukee, Menomonee and Kinnickinnic rivers, but in later years these lines were ignored more or less and encroachments into the water were made when many of the docks were built.

The Harbor Commission, an honorary body appointed by the mayor in 1913 to protect the city's interests from private encroachments, found that maps and data in the city's possession were not up to date and were not reliable. Harbor limit lines had been established by the U. S. Engineers in 1906, and it became necessary for the city to see that no encroachments were made over them. These limiting lines had been laid down from a triangulation survey but had not been referenced to city street corners in a sufficient number of places to make it practical to use the lines for construction purposes.

In order to determine the conditions, the City Council, in October, 1915, authorized a triangulation survey to be made from which the co-ordinates of all street corners and monument stones in the vicinity of the river could be found and also the location of all improvements along the river. Buildings, docks, railway tracks and street lines were to be drawn on large scale maps and the Government's limiting lines and the old-established city dock lines then projected upon these maps. With these data new dock lines could be laid out and permanently established which would be tied in to all street corner stones by means of co-ordinates. Fig. 1 shows the area and waterways included in the survey.

Survey Work and Equipment

The triangulation survey consisted of quadrilaterals spanning the rivers and linked to one another. The precision necessary to obtain the desired accuracy of maps was decided to be not less than 1 in 20,000, and in order to secure this result the steel tapes were standardized, using a 20-lb. pull with an ordinary spring balance. It was found necessary to standardize the tapes about once a month, owing to variation in length All measurements were made using a spring balance and plumb bobs. Thermometers were used, the temperature being recorded and the proper correction made to the measured distance. In each quadrilateral, twelve angles were read, as shown in Fig. 2, each angle being read by repetition six times, three direct and three reverse.

A system of azimuth control lines was run for each river, these lines being connected with a line of every third or fourth quadrilateral, as shown in Fig. 3. These control systems were started at the upper end of the river from lines whose azimuth was found by reading twelve angles to Polaris and checking in the same way. All angles in the control system were read twelve times, six direct and six reverse, and were checked by reading to complement in the same manner.

As the work progressed down the river, side traverses were run from the quadrilaterals down the adjacent streets, so that all street corners and permanent points could be located from stations. It should be understood that nearly all of the quadrilateral stations were not permanent, as it was found that monuments placed near the dock front would shift out of position. Existing docks were located by running field lines approximately parallel to them and taking distances at right angles to these lines. Buildings, tracks and structures were located by angle and distance from stations or substations. Distances were obtained by stadia in this work.

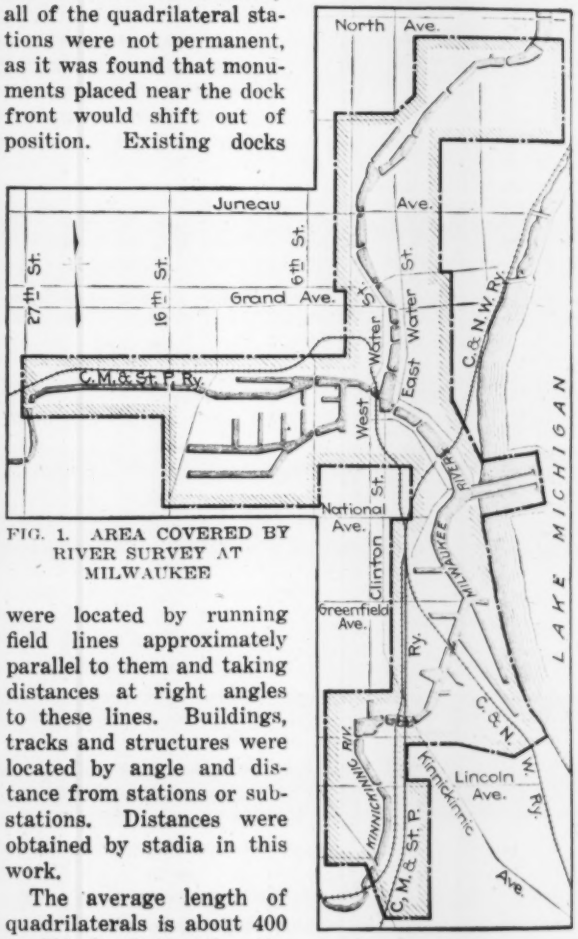


FIG. 1. AREA COVERED BY RIVER SURVEY AT MILWAUKEE

The average length of quadrilaterals is about 400 to 500 ft., being the distance from bridge to bridge, but this length varied with the width of the river, as wherever possible the angles in the quadrilaterals were kept larger than 20 deg. In order to do this the quadrilaterals in the sections where the river was narrow were much shorter than in those sections where the river was wide.

Equipment—The principal equipment of the field party included the following: Transit with 7-in. horizontal circle marked with two rows of figures, reading 0 deg. to 360 deg. both ways and having two double verniers exactly opposite, reading to one minute; Philadelphia rods for stadia work; wood octagonal range poles, 6, 8 and 10 ft. long; steel octagonal range poles, 6 and 8 ft. long; 100- and 200-ft. wire-ribbon tapes;

50-ft. steel and 50- and 100-ft. cloth pocket tapes; plumb bobs, 8, 12 and 16 oz. and 4 lb.; 40-lb. sportsman's spring scale, steel pins and a heavy tripod from an old camera converted for holding a range pole.

Organization of River Survey Party

Only one party has been engaged on the field work and this party normally consisted of the chief of party, an instrumentman, a notekeeper and two rodmen. When certain parts of the work, such as the hydrographic survey, required more men, they were taken from other parties in the city engineer's department.

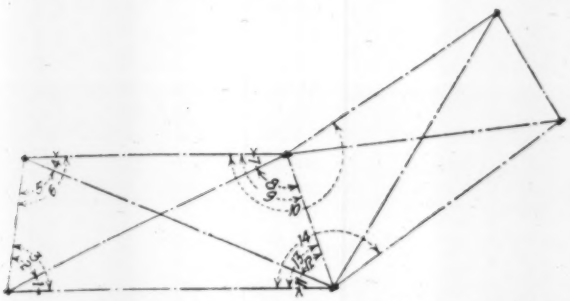


FIG. 2. CONSECUTIVE READING OF ANGLES IN SURVEY

The chief of party kept ahead with a reconnoissance survey approximately locating quadrilateral stations, laying out traverses, looking up street corner stones and office data. It was his duty to see that all street corners needed by the river survey were surveyed and located by the city's division engineers and to see that they set stones at these corners if possible. He generally started the field party each day by giving instructions for the work to be done and then he went out on reconnoissance or laying out advance work, returning to the field party to decide any questions which might have arisen. The chief of party also supervised the draftsmen and explained points not quite clear in the notes. During the winter months he had charge of the compiling of the computations.

The instrumentman had charge of the field party in the absence of the chief of party. He read all angles and did all the instrument work; taking the head end of tape on all chaining while a rodman gave line. Wherever possible all distances were taped and checked, so as to have several measured base lines from which to compute unknown sides. Three men did the taping. Two men had plumb-bobs and set the distances by means of pins, while the third man applied the correct pull by means of a spring balance hooked to the end of the tape. The tape was never laid on the ground or supported in the center, but always hung free from the ends.

The notekeeper kept all notes and made all field sketches. As the reading of angles in quadrilaterals required a large amount of time, he would often go ahead and make sketches of tracks, buildings or docks while the instrumentman kept his own notes of the angles read, which he would give to the notekeeper later in the day. This saved considerable time. It has been found that attempting to speed up the work in the field by taking notes and sketches which are not neat and well drawn is wasteful. When plotting such notes during the winter, more time will be lost in deciphering them than was saved by the speed in the field, and it may be necessary to go back and relocate some of the questionable points. It is considered that the notekeeper is the last man to be crowded for speed.

The rodmen held range poles over the stations, carried the stadia rod, and helped in the taping and all other incidental work. With the tripod already mentioned, a range pole could be plumbed over a point that was to be used for a long time as a sight. When using this stationary rodman or fixed sight, the rodmen could give sights at other points and thus save time.

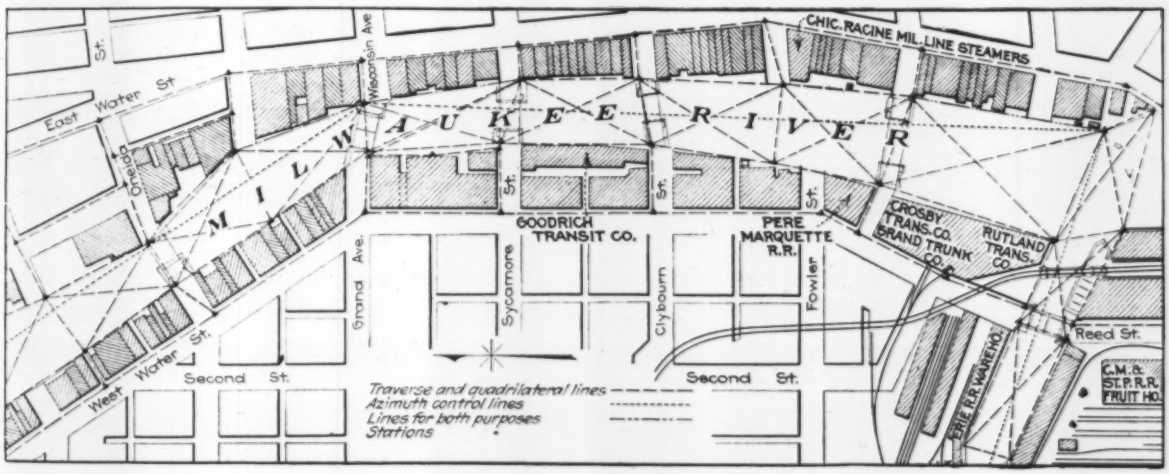


FIG. 3. RIVER SURVEY MAP SHOWING TRIANGULATION AND CONTROL LINES

Stadia Work and Obstruction

Buildings and tracks near the docks were located wherever possible by taking right-angle distances from stations on temporary survey lines run parallel to the dock. Buildings and tracks at some distance from the river, which would not enter into the direct solution of laying out new dock lines, were located by stadia. As stations and sub-stations were close to each other it was seldom necessary to take longer sights than 300 ft. in this stadia work. Only the main corners of the buildings were located by stadia, as the buildings were then measured up with a cloth tape and the distances shown on the sketches.

In some cases where obstructions came in the line

of sight it was necessary to build cantilever platforms from the docks, over the water, upon which to set up the instrument. Such a set-up is shown in Fig. 4. When such stations were used all the necessary field work from them was completed as quickly as possible so that the platforms would have little time to shift out of place before all sights were taken to and from them. Other stations were located on the roofs of low buildings. In general the stations were located approximately at the same level so that no instrumental errors due to the vertical angles entered into the readings of the horizontal angles.

Recording and Marking Stations—Stations were set usually on more or less permanent structures such as

FIG. 4. A SURVEY STATION FOR RIVER TRIANGULATION ON CANTILEVER PLATFORM PROJECTING FROM DOCK WALL

bridge abutments and concrete walks, but where this could not be done sub-stations were set on some permanent structure or on stones and tied in with the main stations. On all such permanent structures crosses were chiseled at the station points, and these were tied-in to arrow marks cut in buildings or structures of a permanent nature. Should any of these stations be destroyed they can can be reset from the tie-in arrows in most cases. The arrows may be used also to locate stations covered by snow, ice or piles of materials. The tie-in points are used also to check stations, to determine whether they have shifted before using them for running dock lines.

Stations were numbered from No. 1 on each river. The sub-stations were followed by letters, as 15-A or 17-A and 17-B, if two sub-stations were set from Station 17. No numbers were chisled near the stations in the field as it was found that the care and time necessary to do good work in cutting these numbers was too great for the advantage gained.

Stones were set wherever possible on street corners that were used in the river survey, but in the downtown districts this was impossible on acount of buildings. In such cases offset points were set from both the intersecting street lines and the point was chiseled and co-ordinated.

Lake-Front Hydrographic Survey

The city has a line of survey stones about 500 ft. apart in a line parallel to the shore along the lake front, for which the co-ordinates are on record. In order to get soudings in the bay, a base line of 1,500 ft. was run between two of these stones and stakes 100 ft. apart were set on this line. The party for the hydrographic survey consisted of two instrumentmen and two notekeepers on shore, with two oarsmen, a sounder and a notekeeper in the boat. The notekeepers had their watches set alike. The sounder had an 18-ft. sounding pole and a red flag. The idle oarsman held the stadia rod. One of the shore instrumentmen had a white flag. To take soundings at right angles to the line of stakes at every 100 ft. stake the following method was used:

Let the shore instrumentman with a white flag be "A" and the other shore instrumentman, "B." When "A" set up his instrument over stake No 1, where the work was to start, "B" set up his instrument over stake No. 10, 1,000 ft. away. Both "A" and "B" sighted at each other and "A" turned off a 90-deg. angle and started the boat out on this line. When the boat was on line the sounder would wave his red flag and sound. All notekeepers would read the time and "A" shore instrumentman, would read stadia distance and angle if the boat had drifted off the 90 deg. line. The "B" instrumentman would only read the horizontal angle. Both "A" and "B" used the stadia rod for target.

The boat would then be rowed further out in the lake, getting line from the "A" instrumentman who was set on 90 deg. again. The distance rowed out would be dependent upon the variation of the lake bottom. The sounder would wave the red flag again and the operations would be repeated.

This would be continued until the boat had sounded out to the distance wanted, which was 1,200 ft. from the shore. After the boat was out some distance, "A" instrumentman would have some difficulty in reading stadia and would mark shots he was not sure of. After the line was completed from stake No. 1, "A" instrumentman moved to stake No. 2, "B" instrumentman staying at stake No. 10. After getting a sight on "B" again, "A" would turn off 90 deg. and line in the boat, which would work towards shore, the method of taking sounding being as described. In this manner four or five lines were sounded and then "B" would move down to stake No. 15 until the soundings were complete to stake No. 10 and "B" would move to stake No. 5.

From this method of getting the field data very few if any shots were lost, as there were several checks. Each notekeeper numbered the shots that were taken, so that with the time recorded and a check by stadia distance, one of the instrumentmen might miss a sounding without getting the whole of the notes confused. The plotting of the first soundings taken without changing the "A" instrument from stake to stake and turning off right angles to line in the boat, showed that in some

cases the boat had drifted out of line so much that the soundings were 200 to 300 ft. apart instead of 100 ft., while in other cases there was a repetition of soundings at the same point.

Computation and Office Work

All quadrilaterals on the rivers were adjusted separately and connected, after which preliminary co-ordinates were computed. Having the location of all docks and co-ordinates for all street corners, monument stones and stations near them, both planing and construction of river improvements and river front work can be laid out from these points. This work is now being completed, and the ordinances are being revised to cover the proper dock lines. It has been found desirable to change some of the U. S. Government limiting lines and when the work is complete the new dock lines will be submitted to the U. S. District Engineer to be sent to Washington to be sanctioned by the Chief of Engineers, U. S. Army.

The detail maps, to a scale of 1 in. to 30 ft., are drawn on sheets 42 x 72 in. The index maps are on a scale of 1 in. to 100 ft. The co-ordinates of stations and the directions and distances of survey lines have been kept in loose-leaf books, in which they are filed at present. It is proposed to show these on the map tracings after the office work has been completed and the U. S. Engineers have sanctioned the new dock lines.

The advantages in using triangulation from co-ordinated street intersections and stones over other methods of survey has been established during the four years' work. Along the river in business sections of the city where obstructions are such that it is nearly impossible to see through with the old method of survey, it has been found very simple to use the co-ordinated points of the triangulation system. This has also eliminated the carrying of lines for several blocks by angle and distance in order to stake out a small piece of dock. Bridges have been staked out in much less time and greater accuracy than by the old way.

The greatest advantage of the co-ordinate system is that in planning work in the office for new bridge or dock frontage, the exact location of such work can be determined from the maps without extensive preliminary surveys, and the work as planned can be located in the field from the co-ordinated stations.

Dock lines were given formerly by the city's division engineers and were described by distances from streets parallel to the docks. But these distances were given only at angle points. When lines had to be given for the construction of a short piece of dock or wharf halfway between the tie-in lines or distances it was necessary to make a field survey to find all angles in street lines and between the intersections of street lines before any computations could be made for staking out the work by going through an alley or between the buildings. This often took two or three weeks to give dock lines that can be staked out now in a day or two by using the triangulation stations as base lines.

This river survey has been made under the direction of the city engineer, Geo. F. Staal, but has been interrupted at times in order to use the party on another large survey for the harbor development plan. The work was stopped entirely for two years during the World War. Beginning with Jan. 1, 1921, the work is being done directly under the Harbor Commission, but previously the Commission turned over a part of its funds to the city engineer, who had a party engaged on the work. The field work is completed, but there are still some maps to be drawn and numerous tracings to be made. As the money has to be furnished from the Harbor Commission fund the work cannot be pushed by engaging a number of draftsmen but must be carried out by the one party which is doing all other engineering work desired by the Commission. This survey was in charge of Ralph Cahill in 1915 and C. S. Gruetzmacher during 1916, but since Jan. 1, 1917 it has been in charge of Herbert C. Schmitt, assistant harbor engineer, who has furnished the material on which this article is based.

Handling Breaks in Irrigation Canal Embankments

Emergency Outfits Stored in Lockers—Questionnaires and Information Needed Regarding Breaks Posted Near Canal

By R. M. Adams
Civil Engineer, Rocky Ford, Col.

THE procedure of getting quickly to a break in a canal bank has been given too little attention by the irrigation managers of the inter-mountain country. Although the writer has worked on several of the large projects he has yet to find one which has an efficient system worked out for meeting quickly any and all contingencies that arise at times of washouts in large canals.

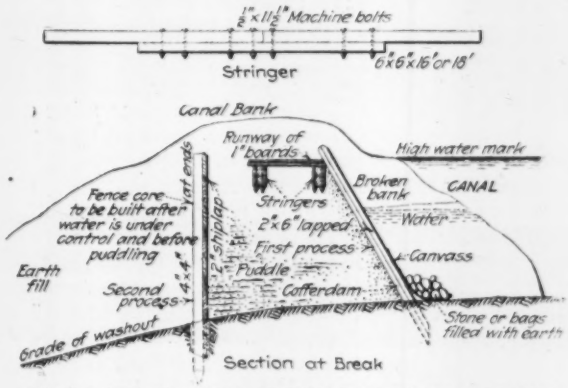


FIG. 1. FENCE CORE METHOD FOR SMALL BREAKS

While superintendent of construction of one of the largest irrigation systems in the country he proposed a system that would make it possible to get breaks repaired quickly and for small overhead expense. A list of the repair materials and tools suggested is listed below. It is incomplete, but will be corrected when time shows up its deficiencies. There was not installed, however, what the writer considers a most important procedure of any recommended, i. e., the posting of a questionnaire to which anyone who first locates a break may refer for the information most needed at headquarters.

In any emergency the operating force must be under instructions and know the prearranged plan if the efforts of the construction and repair gangs are to be quickly and efficiently of use. All openings in canal

banks found by an employee of the canal company and not immediately repaired by him should be reported by the quickest means available to headquarters. The following facts should be given in every instance: (1) The location of the opening with respect to some well-known structure, to a mile post, or with respect to the owner of the land immediately below the opening; (2) the best way of getting into the right-of-way of the canal, if the water has covered roads, and means of approach if the canal bank is cut off; (3) the width of the opening when last seen, the amount of water flowing and the rate at which the bank is disintegrating; (4) the opening of any spillway to relieve the canal of the head of water running at the break, and what, if

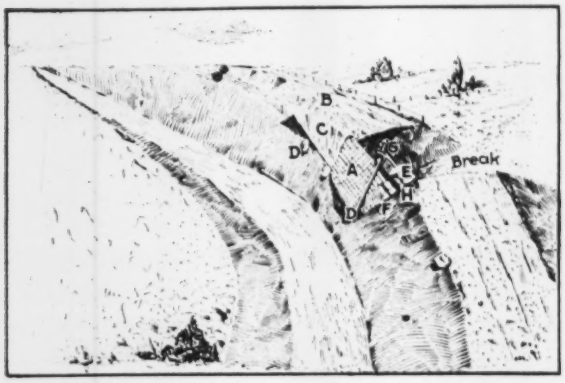


FIG. 2. HOG WIRE AND CANVAS FOR HOLES NOT OPEN TO TOP

A is hog wire, cut off at break, held in place by iron pins B. C is canvas, cut away at opening. Both wire and canvas are supported by pole G. Sacks D hold down wire. Sacks E and F make first and second wall to hold puddle H.

anything, has been done to stop the water running out.

With these facts established, the construction superintendent at headquarters will be able to load out on trucks and automobiles such personnel and equipment as the case will demand. As a secondary precaution, such tools and materials as would be needed in the worst contingency that could result from a break at the place reported, are loaded ready to send on a moment's notice. Men and tools to repair a 4-ft. break may be loaded into a five-passenger Ford car and driven to the scene of operations at the rate of 30 miles an hour over good roads. For a break the width of which is over 10 ft. trucks may carry tools, materials and laborers, at a rate of from 15 to 30 miles an hour.

To assure small loss of time in attending a washout the four required statements concerning a break should be posted at the homes of all farmers, or others, who live immediately under the canal. A large percentage of the reports of trouble comes from people who live near the canal and it has been found that ordinarily the ideas conveyed to the headquarters office are misleading and erroneous. If the informants knew just what to look for in order to make a report, more definite action could be taken immediately.

If the methods described are used, in most cases the water need never be turned out of the spillways to relieve a section at a break. Only such breaks as are close to a spillway or to the upper end of the canal need have the water turned out for the efficient repair of the bank, unless the length of the opening is over 50 ft., or a somewhat lesser length when the banks are built of material that erodes quickly.

In addition to the list of tools, shown in the accompanying table there is appended a sketch of the process of repairing a small break. For a larger place most of this material would be out of place and too slow.

In repairing breaks which have not opened the top of the bank it is possible to replace the cofferdam of

EMERGENCY TOOLS FOR CANAL BREAKS

To be kept in lockers, securely locked

2 single bitted chopping axes	1 piece of canvas, 10x20 ft.
2 post mauls	1 ball binding twine
2 striking hammers, 3 lb.	2 large sacking needles
2 ripping hammers	1 6-ft. cross-cut saw
2 hand axes	1 peavy
2 doz. ⅞x11½-in. machine bolts with washers and two nuts on each bolt	1 42-in. duckbill timber carrier
	2 pairs of heavy wading breeches
1 keg 10d. nails	1 brace and set of bitts
1 keg 30d. nails	2 seven-point hand saws
1 keg 60d. nails	1 steel carpenter's square

To be kept in bundles, and used only in emergency

3 picks with handles	3 grub hoes with handles fitted
6 l.h.r.p. shovels	1 logging chain with hooks
2 saw trestles with 30-in. legs	2 bundles (100 ea.) cement sacks
100 ft. ¾-in. manilla rope	1 diaphragm pump

To be kept in bulk, and used only in emergency

3 pcs. 6x6 in.—18 ft.	6 pcs. 4x4 in.—16 ft.
3 pcs. 6x6 in.—16 ft.	20 pcs. 2x4 in.—any length
10 pcs. 2x6 in.—16 ft.	300 lin.ft. 2x6 in.—any length
2 two-horse fresnoes	30 pcs. shiplap, 2x10 in.—length unimportant
6 slip scrapers	

the sketch, Fig. 1, with an obstruction made of hogwire pinned down to the slope of the bank on either side of the opening by 4-ft. iron pins. The pins should preferably be placed at some distance from the edge of the break, and if carried back far enough may all be above the water, as at *B*, Fig. 2. Canvas may then be placed over the hogwire and weighted with sacks of earth on the outer and lower edge. The last process of tightening up is then done by throwing earth from the bank onto the small leaks remaining under the canvas. To prevent too much sag the hogwire is generally reinforced by one or two posts fixed as at *G* after the water is cut off. Then a row of half-filled sacks is placed as at *E* and a second row at *F*, some 6 ft. from that at *E*. Puddle is then put in between the two rows of sacks. This construction takes the place of the fence core in Fig. 1. In an actual case the water was cut off in 20 min. after the materials arrived at the break. Three men did the work and the whole repair was made in 3½ hours.

The total cost of the tools and equipment, not including the timber and the lumber as given in the list above is about $250. This figure includes wrenches to screw up the nuts as given in the list, also hogwire, canvas, a pair of 12-in. side-biting lineman's pliers, 300 ft. of soft core cable, Crosby clips, a snatch block, 100 ft. of ¾-in. sash cord for casting and a crowbar or two.

Whether the method as shown in Fig. 1 is used or one similar to that shown in Fig. 2, the water will be in the lower reaches of the ditch long before it would were the water cut off to repair the break. If the latter process is used slip scrapers can be used on each broken end of the bank as soon as the line of sacks is built up under the bank end whether or not the middle portion of the breech has been walled up with sacks. There is no other way that backfilling can be done until the space between the fence core and the cofferdam is entirely filled with puddle to the height of the dirt outside the fence core. The fence is a rectangular, square-cornered thing, and a trench just the right dimensions must be made for it. In the sack wall method, any shape will be fitted by the sacks of earth snugly and solidly.

Rival Arguments on the Public Works Department

American Association of Engineers Replies to Statement Against Department Ascribed to Chief of Engineers

UNDER the title "Reorganization of the Government Departments" the American Association of Engineers has just issued a pamphlet of 25 pp. which not only contains a "suggestive plan for grouping engineering activities to effect economies" in the government departments, but also answers in some detail a statement entitled "Proposed Department of Public Works" which the A. A. E. pamphlet assumes to have been issued by the Chief of Engineers, U. S. Army, to his officers and assistants. While this assumption is doubtless correct, it should be stated that the document in question, in one form a folio typewritten manuscript of 19 pp., is anonymous and is not openly acknowledged by the office of the Chief of Engineers.

The manuscript statement, "Proposed Department of Public Works," is an argument against the adoption of such a department. It starts off with the assertion that the engineering work of the different departments of the government is only incidental to the primary functions of these departments, and cites the Indian Service, which requires lawyers, engineers, teachers, doctors, and ministers of the gospel. The argument continues "It is plain that efficiency would not be promoted if all the legal work of this service were intrusted to the Department of Justice, its engineering work given to the proposed Department of Public Works, its teachers placed in the Bureau of Education, its doctors in the Public Health Service, and its ministers in the Chaplains Corps."

The argument next refers to the referendum of the Chamber of Commerce of the United States, which was against the Public Works Department. It follows with a claim that the proposal to limit the President to an engineer for appointment as secretary of the department is unwise and probably illegal and contrary to the spirit of our institutions. It claims that such departments in other countries and in states have no wholesale collecting together of large and diverse bureaus, but only a few separate engineering functions, such as, for example, roads, bridges, and canals. "No country has actually tried to place all kinds of engineering work in a single department."

Military Construction by Army

In consideration of the bill proposed for a department of public works, the argument says that "the provision transferring military construction to the War Department would certainly lead to lack of co-ordination and to the waste of public funds in times of peace, and to worse results in times of war; while the provision transferring the river and harbor activities from the War Department would sensibly diminish the resources available to the country for national defense, and in normal times produce increased expense rather than economy." The argument then proceeds to analyze the functions of the various branches of the government which are to be included under the proposed department, prefacing the analysis with a claim that the activities which the bill proposes to transfer are essentially independent lines of work, and argues that one would not expect a great firm of architects to undertake the wholesale construction of inexpensive dwelling houses; or engage dredging contractors to build a reservoir in the hills.

In the analysis of the river and harbor improvement work, the argument emphasizes the highly specialized character of this work, the difficulties in training men to understand it, and the necessity for long experience before responsibility can be placed. It is stated that the problems of the Reclamation Service, for instance, are in general directly opposite to the problems met in river and harbor improvement, with the consequent deduction that there is no reason why the experience of the one should be of help in the other. It is insisted that the administration of the laws of navigable waters is one of the most important duties under the River and Harbor Act.

Continuing the analysis of the various departments, it is stated it is a mistake to think that the same preparation is needed for the land surveys of the Geological Survey and for the hydrographic work done by the Coast Survey. There is an apparent overlapping of the map work done by the Geological Survey, the Coast and Geodetic Survey, and the Corps of Engineers, but this overlapping is small, since each of the services makes full use of the work done by the others. It is argued that the Bureau of Standards, the Bureau of Public Roads, and the Forest Service are all of such special character that it would be better to have them independent and that there is nothing to be gained by interchangeability of personnel, although it is added that "as a part of its duties as military engineers, the Corps of Engineers of the Army must be familiar with highway work, and has performed important work of that character in the past."

Defense of the Corps of Engineers

Following paragraphs argue against the transfer of army construction from under the War Department and of the taking of the river and harbor work from the Corps of Engineers. The latter arguments take up practically all of the rest of the document and are the most elaborate of the whole statement. It in effect is a defense of the Corps of Engineers both in its peacetime and its war-time activities. Certain sentences will be quoted at random to indicate the trend of the argument.

It is idle to elaborate on the fundamental principle that the defense of the country is the first duty of the government. Wherever the military resources of the country can be increased without undue cost, the necessary measures to that end are desirable. But when the test of war has just proved that a certain organization of the government adds material military resources for the defense of the country, without cost to the United States, it is folly to entertain the idea of its destruction. . . . The engineer troops of the United States forces . . . were organized and equipped with a minimum of friction or delay. . . . While other bureaus may have been swamped by demands incident to the war, the Engineering Department successfully expanded without any fundamental reorganization. . . . It thus fell to the small nucleus of regular officers of the Corps of Engineers to supervise and operate an organization more than twice as large as our pre-war army, and engaged in work which involved every conceivable form of engineering practiced by the profession in the United States. . . . It would have been impossible had not the Chief of Engineers had at his disposal a group of officers who were acquainted with the personnel and practice of the engineering profession, and competent to

direct members of that profession; and who at the same time, by virtue of being commissioned officers of the army, were able to co-ordinate the work done with military exigencies. This combined training in civilian and military practice has been attained only by the existence in time of peace of a group of officers engaged with profit to the nation in river and harbor improvement, but with the military training and experience to mold, train, and direct the mass of engineer material which in time of war is so hastily summoned. . . . In time of peace the Engineer Reserve Corps looks to the regular officers of the Corps of Engineers for such training and organization as is given them. . . . To take away from the Corps of Engineers its peace-time training in practical engineering is largely to destroy its ability to control and operate this splendid reserve from civilian life. . . .

The Engineer Department labors under no delusion that its performance during the past war was perfect. There were failures of individuals, not confined to those who entered for the period of the emergency. The failure of individuals to measure up to the demands of war is as unavoidable as are casualties from hostile fire or from disease. It can be met only in the same manner, by replacement of the individual. It in no way affects the organization as a whole. It is a fact that a considerable number of engineers were placed in positions where their abilities were not fully utilized. Such waste is, however, but an incidental feature of the wasteful business of war. It was far less than would have been the case had the regular officers of the Engineer Corps not been in a position in which they enjoy that extensive acquaintance with engineers in civil practice.

Department Discourages Preparedness

The statement then argues against the theory that temporary duty under the Department of Public Works would succeed in giving the officers of the Corps of Engineers proper instructions, training, and experience because they would not have under the department proper responsibility. It is responsibility that they need in their peace-time activities. Furthermore, there is a danger that if the Corps were separated from its peace-time work and kept only on fortification work and military duties, it would become extremely difficult to justify the maintenance of a considerable number of engineer officers and the Corps would dwindle below the necessary strength as a protection against possible war. It is then stated that the Corps of Engineers have very much lower salaries than would be given to civilians on the same kind of work, so that money is saved to the government by the present arrangement. The conclusion is that the object of the bill and its effect if enacted into law is to relegate the officers of the Corps of Engineers in time of peace to study without practice, to deprive them of the possibilty of acquaintanceship with the profession which is necessary in war-time when it is their duty to so place civil engineers who come in as temporary officers as to obtain the greatest value of their services.

The final paragraphs state there is no widespread and well-founded public demand for the measure, but that it is merely a criticism of a policy of Congress; that the new department will merely provide an organization precisely similar to the Corps of Engineers, except that the men entering the new service would not have received the training traditional with the Military Academy.

After the argument against the department there are some pages devoted to a suggestion that the War Department would be glad to co-operate with other governmental agencies having duties allied to those of river and harbor improvement, and that the Chief of Engineers would be glad to join a conference for the purpose of formulating a program for any further co-operation that may prove to be practicable either as to expenditure of public funds or the more advantageous use of personnel and information now available. It is suggested finally that Interior Department has a number of its own bureaus which would bear consolidation and that such consolidation should take place before the general consolidation or reorganization of the government departments.

A. A. E. Favors New Department

The A. A. E. pamphlet says that it has been prepared by some of its members to "serve as an answer to the circular recently issued by the Chief of Engineers of the United States Army to his officers, giving his reasons for opposing the reorganization of the engineering activities of the government." It starts off with an accusation that the Corps of Engineers realizes that if it were once to lose its river and harbor and other civil works, it would never regain them and that it is now making a desperate effort to hold the civil works which it still has. It denies that public works are incidental to the primary functions of the various departments. It states, on the contrary, that "the great bulk of our public works, other than those pertaining to national defense, rarely bear a close relationship with the departments under which they are at present." It contends, in opposition to the circular, that an architect would certainly be better fitted for the management of a large survey than a military commander or a collector of internal revenue; that he would be better able to undertake the wholesale construction of inexpensive dwelling houses, than would officials who had no technical knowledge of architecture. It asks the question, "Would not the ordinary general medical practitioner be better fitted to perform a surgical operation than the best lawyer at the bar?" It states that the proposed department would have experts in all lines, and the executive could always select a man who would be specially suited for any work. In addition to an interchangeability of personnel, there would result a corresponding interchangeability of plant and equipment.

It states that co-operation alone would not be sufficient and cites the case of the Board of Surveys and Maps which has been trying to co-operate for two years but which has reached no practical results.

The report denies the extreme technicality of the laws affecting navigable waters and doubts whether they could not be readily learned by a new group of men. It charges that the Corps of Engineers has not been particularly successful in the administration of the laws.

War Experience of Engineer Corps

The argument then reverts to the war experience of the Corps, and states that the schooling of the army engineers on civil work was no real help to the engineering organization in France. "There are many regular army engineers whose work in France is entitled to the highest praise, but that in all fairness to the individuals concerned, there is much which indicates that the regular engineering organization, so far as that organization functioned in this matter, was as often an obstacle to the work in France as it was an aid in its execution. Much of the success achieved by many of the regular army engineers who were in France was due much more to their ability to get favorable action

at headquarters where they knew the ropes and could obtain a hearing, than to any previous schooling which these men had had with civil works." It is claimed that much of the most important engineering work, for instance, the railroad service, the chemical warfare service, the purchasing department, the construction and operation of the ports, the construction of many of the cantonments, hospitals, etc., had to be taken from under the Chief Engineer and placed with a temporary officer, generally a civilian at its head. "The Corps of Engineers as an organization by no means has the right to claim any major part of the credit for such engineering successes as were achieved in France, and cannot properly use such an argument in favor of its retention of civil works which are in no way incident to the primary functions of the army."

In opposing the control of civil works by army engineers, it is claimed that there are equally good engineers in the government service and that the army engineers only have control of it because of precedent; that conditions now are somewhat different than in the early days, in that the General Staff of the army has now control over the Corps of Engineers, and that the General Staff is not made up of engineers. It concerns itself solely with the efficient management of the army as a fighting machine, and so may possibly destroy the efficiency of the engineers in administering civil work. Instances of this are the frequent changes of station of the engineers, with the result that responsibility on work cannot be fixed, the man who makes the estimates very frequently not being the man who has to carry out the execution of the work.

It is stated that the army, outside of the Corps of Engineers, approves the separation of the Corps from civilian work. It is also stated that in no other country are the army engineers engaged in civil activities.

Assistant Engineers' Status

Opposition to the ability of the Corps is made in a claim that the United States Military Academy is not an engineering school and that the men selected for the Corps because of their being at the head of their class are generally those of high mathematical ability, and that mathematical ability does not necessarily mean engineering ability. The lack of practical engineering training, such as the ordinary civilian engineer gets, is emphasized.

Several pages are devoted to the civil engineer's lowly position under the Corps of Engineers, and the un-American situation whereby there is a horizontal demarcation above which the lower grade men cannot possibly rise. It is also charged that on account of the enormous multiplication of paper work, in reality the clerks in Washington and in the various engineer stations control the activities of the Engineering Department.

The final pages disclaim any intention on the part of the writers of the report, at least, of forcing the actual construction work of the War or Navy Department into the proposed department. It is stated that all of those engineering functions necessary to those departments should be performed by themselves. The remainder of the report is devoted to an analysis of the proposed department not very different from analyses which have been made before. It includes in that statement that "it is believed that the fortification and other engineering activities left with the army, together with the command and management of engineer troops therein, will offer all of the engineering schooling needed by these regular officers, will increase their usefulness for the army itself and will not entail so many delays and so much wastefulness as do the present methods."

Airplane Shed With Special Roof and Door Construction

Truss Sections With Interlocking Joints—Overhead Kneebracing—Counterbalanced Pivoted Door 21 x 100 Feet

IN THE construction of a shed for mail airplanes at Reno, Nev., a quick erection form of steel roof truss framing was adopted by the engineer, J. B. Strauss, of Chicago, and an adaptation of Mr. Strauss' well known form of bascule bridge counter-weighting was applied to the pivoted door which forms one entire end of the shed.

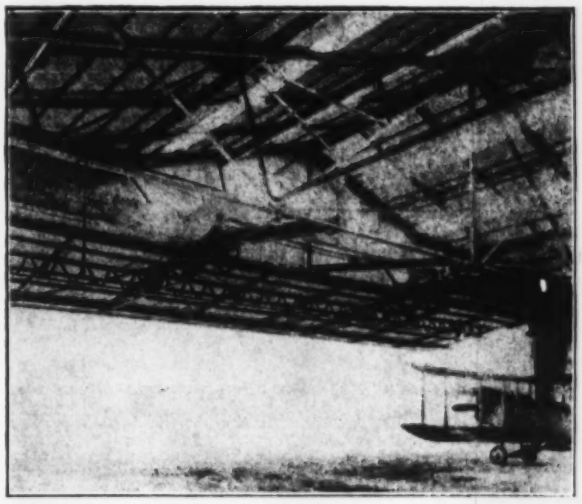


FIG. 1. RENO AERIAL MAIL HANGAR, SWINGING DOOR OPENED

This door, 21 ft. high and 100 ft. long, trunnioned at the top of the door jamb, can be opened in 20 sec. Its counterweight consists of a concrete mass supported by and inclosed in a latticed steel framing, of total weight 37,500 lb. It is held in vertical position, whatever the position of the door, by a counterweight connected to the roof truss. The door itself is covered with asbestos corrugated sheathing. A 5-hp. motor through a train of gears operates two pinions engaging cast-iron racks bolted to the door girders.

Eight De Haviland 4B airplanes can be accommodated in the shed, and in addition there is a complete workshop for building and repairing planes. The dimensions of the structure are 105 x 105 ft. overall with a clear vertical headroom of 18 ft. The roof trusses are carried by wide latticed steel side columns, and to avoid reduction of clearance at the corners by kneebraces are braced to the column above the sloping roof line by horizontal struts attached to extensions of the columns above the heel of the truss.

Quick assembly joint construction was developed by the designer to simplify the erection. Each truss was shop assembled in two triangular sections, leaving the center portion of the bottom chord, the middle hangar,

and kneebraces separate shipping pieces. To seat the heel of the truss at the column a shelf bracket was provided, the peak joint of the two half sections was developed as a butt joint, and the middle section of the bottom chord was fitted with lug plates at each end adapted to hook over and engage similar lug plates attached to the splice and bottom lateral plates attached to the truss section. It was therefore necessary only to lift the two truss halves into position and set the bottom chord section in place to engage, whereupon the truss was self-supporting and could be bolted up at leisure. The middle hangar and the kneebraces have ordinary bolted joints without lugs for quick placing.

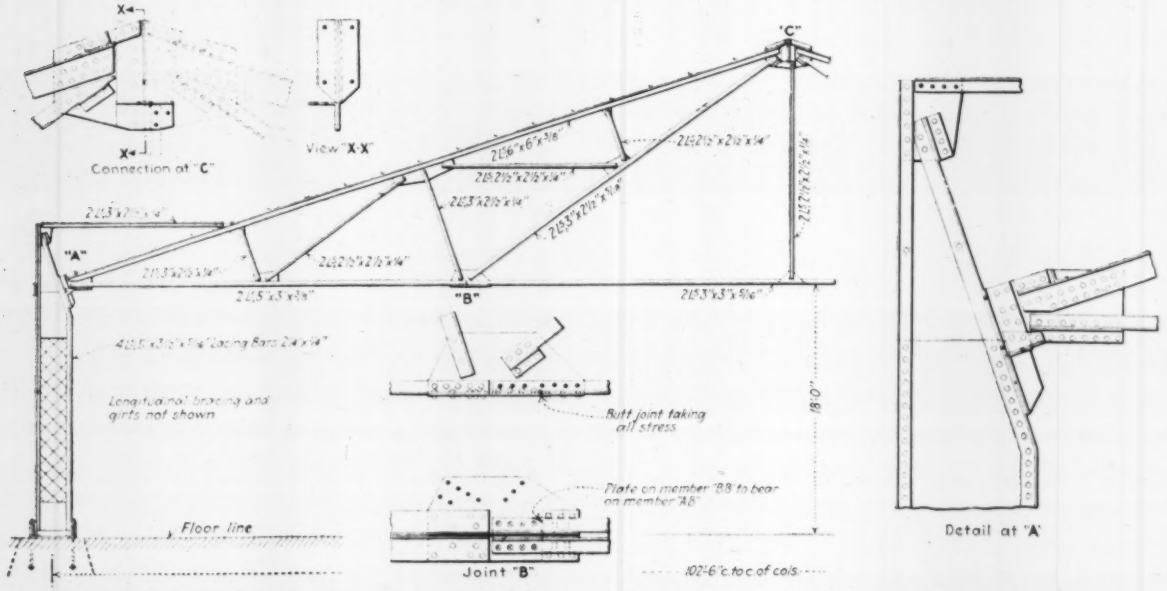


FIG. 2. ROOF DETAILS OF RENO AIRPLANE SHED WITH INTERLOCKING JOINTS AND OVERHEAD KNEEBRACING

The shed was built for the city of Reno and the county of Washoe. Patents are pending on the roof construction. S. H. Newton of Reno was the erection contractor.

Plan to Revise Building Code at Indianapolis

A number of important changes in the building code are embodied in an ordinance prepared for the city council by a committee of the Chamber of Commerce of Indianapolis in co-operation with Walter B. Stern, city building commissioner, and representatives of the various interests affected. Eight-inch brick walls for two-story construction are to be allowed where now 12-in. walls are required in the first story of a two-story dwelling. Frame buildings less than 4 ft. from the property line would be required to have 4 in. fireproof filling in the spaces between the studs, and no frame building would be allowed to come within 2 ft. of the property line. Steel lumber floor construction would be permitted in first-class buildings, the requirement for hollow tile or concrete fireproofing now imposed being rescinded for this purpose. A further proposal that has been made, but is yet under consideration, is to provide that all wood shingle roofs must replaced by fireproof roofs within a fixed period of years, and that the replacement of wood shingle roofs that have been damaged be further restricted. The present code requires that when 50 per cent or more replacement is necessary fireproof material be used. The proposed limit is 20 per cent.

Quick Hardening Cement Developed By the French

New Fused Product of High Alumina Content Should Prove of Value in Many Kinds of Construction

BY EDWIN C. ECKEL
Consulting Engineer, Washington, D. C.

IN THE course of the World War a cement of very remarkable type and properties was put into use by the French for special military purposes. Its high technical value, in certain limited fields, is such as to make it advisable to briefly discuss its characteristics. As an introductory summary we may say that it is a lime aluminate, differing from normal portland cement in the almost total absence of silica; that it is prepared by actual fusion, not by mere clinkering; that it is almost white in color; and that it will harden with such rapidity as to make a good heavy-gun platform within 24 hours. It will be seen that it offers certain possibilities for other than military uses; and that products of this general type may become of interest both to American cement manufacturers and to American engineers.

Of course it is well known here that, a decade or more ago, Messrs. Lazell and Spackman began investigating the possibilities of high-alumina cements, and took out a series of patents in connection with them. Some of the processes then developed have come into use, particularly in connection with the lime industry, where it was found that the addition of a lime aluminate aided greatly in giving a more rapid hardening to limes and lime plasters. But so far as I know, none of the products made for that purpose were ever, commercially, real aluminates of lime. They were made in the majority of cases from a furnace slag which carried abnormally high alumina, because it came from furnaces running on the brown iron ores from the north coast of Cuba.

What is less commonly known, however, is that a

parallel series of investigations were being carried on in France, at about the same time, and that these have resulted in an entirely different series of commercial products. The French patents were taken out in 1908 by the well-known firm of J. & A. Pavin de Lafarge, who are among the largest French manufacturers of both portland cement and hydraulic lime. During the war the A. E. F. operated some of the Lafarge plants, and while in charge of that work it was possible to observe the manufacture and characteristics of the fused aluminous cement which was being made at a neighboring plant for artillery mounts. Such notes on the subject as seem of general interest are presented here.

Lafarge Fused Cement

The Lafarge quick-hardening aluminous cement was marketed as *ciment fondu* or fused cement, and for the sake of brevity that term will be used hereafter in this article.

The fused cement is made in a small blast furnace, which is charged with coke, limestone and bauxite. When the furnace is in steady operation it turns out from ten to fifteen metric tons a day of fused slag or clinker. This slag, cooled and ground, is the Lafarge fused cement. In composition it does not vary greatly from

Lime	50 per cent
Alumina	40 per cent
Silica, etc.	10 per cent

The silica noted comes in chiefly from the impurities of the coke, but in lesser part from the bauxite, and to a very slight extent from the limestone used. The fused cement, as will be seen from the above note, is far lower in lime than the normal portland cements, a characteristic which it shares with the high-iron cements occasionally made and used.

So far as cost of manufacture is concerned, the fused cement can obviously be made at least as cheaply as a normal portland. Its uses will be determined then, not by cost, but by its special characteristics, which give it value in certain fields of work, but limit its use in other lines. We may note briefly some of these characteristics.

Setting, Hardening and Strength

The fused cement has a normal setting time, falling in this regard within ordinary portland cement specifications. It can therefore be mixed and worked without taking any extraordinary precautions.

Its hardening, however, takes place with far greater rapidity than does that of a normal portland cement, so that a 24-hr. test will give results for the fused cement which are rarely obtainable with portlands under 28 days. In saying this it must be kept in mind that I am speaking of French cements used in French climate. The average American portland, used in the United States, will both set and harden faster than the usual European portland employed abroad.

Laboratory tests on the fused cement gave the following results, the briquettes and cubes being made up of a 1:3 mixture of cement and sand.

RESISTANCE IN KILOGRAMS PER SQUARE CENTIMETRE

Age	Tension	Compression
1 day	29 kg.	352 kg
2 days	34 kg	387 kg
3 days	34½ kg	400 kg
7 days	35½ kg	451 kg
28 days	37½ kg	475 kg

Obviously there are great advantages in the use of a quick-hardening cement of this type under special conditions. For marine work which is to be completed between two tides we have available a satisfactory material, and as will be seen later it is also a cement resistant to marine action.

Resistance to Decomposition

Considering the composition of the fused cement, its most remarkable property perhaps is its resistance to the decomposing effects of sea-water and similar solutions, for until the Lafarge cement was introduced there was a tendency to ascribe the breaking up of portland cement in sea water to its content of alumina, and to search for cements low in alumina. Yet here we have a cement with a very abnormal alumina content which seems to be perfectly resistant to marine action.

The Paris-Lyons-Méditerranée R.R. used fused cement on a portion of its line along the Mediterranean, where normal cements are badly affected by exposure to sea air and salt water; and the fused cement is reported to have stood the exposure admirably.

In laboratory tests, for which records of nine years' standing are now available, the fused cement has been kept in three solutions: (1) Sea water, (2) water saturated with lime sulphate and (3) water carrying 1.2 per cent magnesium sulphate. The cubes kept for nine years under these three very trying conditions are absolutely intact.

Briquets of neat cement, composed of fused cement to which gypsum was added in all proportions up to 50 per cent, have been kept in water since 1908 without the least signs of disintegration.

In view of these facts it seems evident that we must broaden our ideas as to the possible modes of securing protection of cement against the action of sea water and of other strong solutions. I was not able to secure data regarding the resistance of the fused cement against highly alkaline or acid solutions, a matter which is yearly becoming of greater industrial importance. It is to be hoped that some laboratory which has the facilities for carrying out such tests may take up the matter in proper detail.

To sum up the matter, we are dealing with a cement of entirely new type, which seems to be well worthy the consideration of American engineers and chemists. None of the Lafarge fused cement has ever been shipped into this country; and no cement of that type has, so far as I know, ever been made here by anyone else. In view of the history of the Spackman and the Lafarge patents, it is questionable as to how far any patent rights can now cover the product above described in the United States. The commercial side of the matter is therefore uncertain; but as a technical affair it is certainly worth more attention than has been given to it heretofore.

Mineral Production

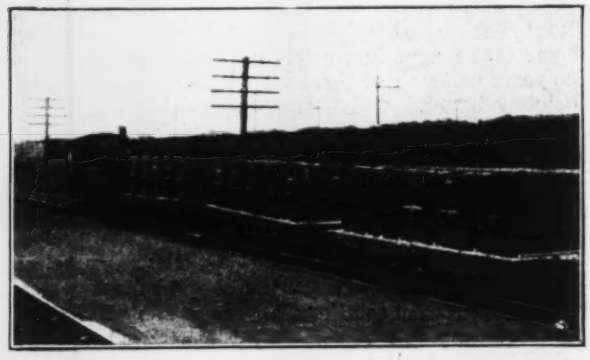
According to statistics compiled by the United States Geological Survey, in co-operation with the Census Bureau, the gold, silver, copper, lead, and zinc mines in the United States, exclusive of Alaska, produced during 1919 approximately 61,839,000 net tons of ore containing 1,833,309 fine oz. of gold, 51,224,300 fine oz. of silver, 582,500 net tons of copper, 443,000 net tons of lead, and 549,000 net tons of recoverable zinc. The placer mines yielded approximately 474,000 fine oz. of gold, 45,400 fine oz. of silver, and 800 oz. of crude platinum.

Heavy Narrow-Gage Locomotives on Concrete Road Work

Twenty-Ton Engine Hauls Five 22-Ft. Cars Carrying 25-Batch Boxes—Three Trains Serve Five-Bag Paving Mixer

BY B. H. PIEPMEIER
Engineer of Construction, Illinois Division of Highways, Springfield, Ill.

TWENTY-TON, narrow-gage locomotives received by the Illinois Division of Highways in the distribution of surplus war equipment, are being successfully used this season for dry batch haulage in concrete road construction. The size of the locomotives made their economic service doubtful and to determine the facts it was decided to give them a trial in day-labor construction where their use could be controlled by the state engineers. There were three 20-ton, 24-in. gage, Vulcan steam locomotives and several miles of 25-lb. rail received from the War Department. The work selected was a 7½-mile, 18-ft. concrete road between Dwight and Odell in Livingston county.



TWENTY-TON ENGINE AND FLAT CARS EACH CARRYING FIVE 5-BAG BATCH BOXES

Sectional track was not adopted. The 25-lb. rails, varying in length from 12 to 30 ft., were spiked to 4 x 8-in. x 4-ft. wood ties with ⅜ x 3½-in. spikes. All joints were fastened by standard four-bolt fishplates. The ties were spaced 22 to 24-in. on centers and the track was partially ballasted with earth. Its center line was placed 5 ft. from the edge of the proposed line of the 18-ft. pavement, to permit the cars and locomotives to clear the finishing machine.

Three locomotives and thirty-six cars were installed. The locomotives have three drivers on each side and front and rear trailers. They normally pull from five to eight flat cars, each of which is loaded with five, 5-bag batch boxes. The cars are about 6 ft. wide and 22 ft. long and have a double truck under each end, the dead weight being about 4 tons each. The locomotives have sufficient power to pull from ten to twelve loaded cars over the road, which has less than 2 per cent grades. Since the track is not made up in sections, switches cannot readily be installed, therefore, the line is provided with a permanent switch about every mile.

The first loaded train in the morning and the first after the noon hour, pushes out five extra cars, or twenty-five batches, and leaves them on the track in advance of the mixer. One locomotive is kept at the mixer to spot the batch boxes for the mixer, and when the train is emptied it couples onto the five cars held in reserve and pulls them back to the mixer for use while the approaching loaded train pulls out the empties and puts the loaded train in reserve. The locomotive at the mixer then couples onto the train that has been spotted at the mixer. In this way, the twenty-five batches kept in reserve supply the mixer during the time the loaded train is being switched into place.

A 21-E paving mixer, with boom and bucket delivery and a loading derrick with a reach of 14 ft., is used. A 10-ton roller, a subgrader and a finishing machine make up the equipment around the mixer. From June 15 to Aug. 13, the mixer had operated 44 days, and had laid 3.04 miles, or an average of 365 ft. per day. This record, considering the equipment and the entirely new gang that had to be organized, met all estimates and expectations. It is hoped that the 7½-mile section will be completed this season.

At the central proportioning plant there is a 60-ft. stiff-leg derrick with a 1-cu.yd. clamshell. Small bins are used for sand and stone, each bin having a capacity of about one carload. The cement shed has a capacity of about eight carloads. Sand and stone are brought in by rail. Water is supplied by a 2-in. main from Dwight or Odell, with a large steam pump to boost the pressure. The plant is located about ¾ mile from one end of the 7½-mile section. It is expected that the three locomotives with the 140 batch boxes will supply ample material to the mixer even on this long haul.

H. W. Hartmann is superintendent in direct charge of the work, and C. S. McArdle is general superintendent for the department.

Standardization of Brass Goods for Water-Works

THREE committees recently appointed by as many associations to draw up a scheme for the standardization of brass goods for water-works met at Bridgeport, Conn., during the recent convention of the New England Water-Works Association and unanimously adopted a report to be submitted to their respective organizations. The associations and their representatives are: New England Water-Works Association, David A. Heffernan, Milton, Mass.; American Water-Works Association, W. R. Edwards, Paterson, N. J., and J. Walter Ackerman, Watertown, N. Y.; National Association of Brass Manufacturers, Fred Mueller, H. Mueller Mfg. Co., Decatur, Ill.; and Fred Schulder, United Brass Co., Boston, Mass. The committee decided that for all brass goods to go underground the metal mixture should be standardized, with a specification of definite "limits of tolerance for each ingredient," and "that all essential dimensions be standardized and minimum weights specified." It was decided to ask the American Association of Brass Manufacturers to submit suitable specifications to cover the metal mixture and the dimensions and weights.

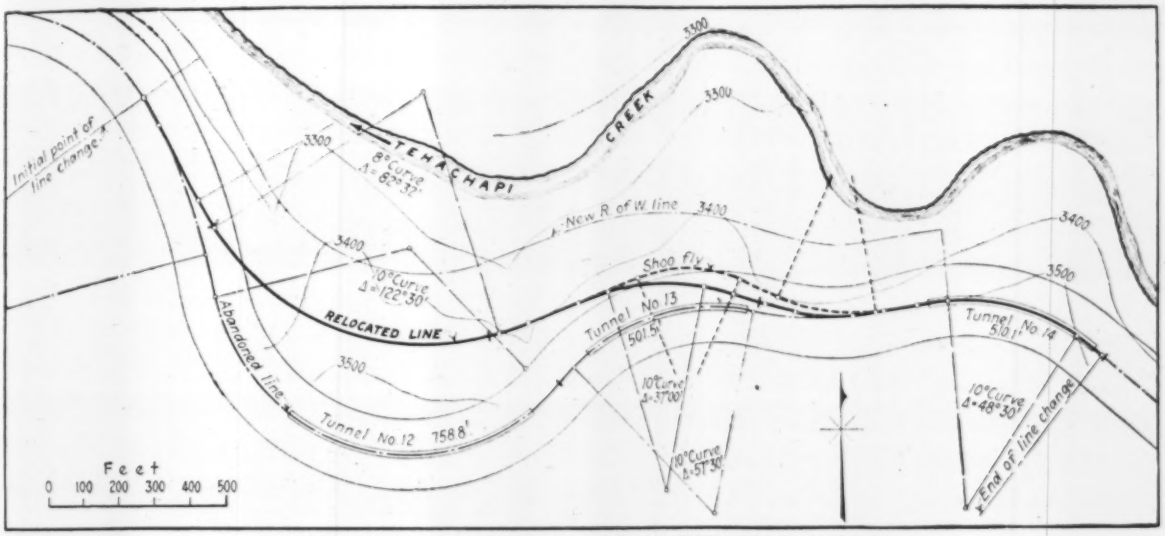
The following eliminations from corporation cocks were decided on: (a) The ⅜-in. size; (b) all round bodies; (c) female threaded outlet; (d) hex plug recess; (e) Mueller coupling thread; (f) quarter-bend coupling; (g) increasing size lead flange cocks; (h) lead flange cocks for 1-A lead; (i) on the sizes smaller than 1¼-in. to eliminate squares and hexes; and also to discourage the use of the ½ and the ⅝-in. sizes. Many recommendations for corporation cocks, for curb cocks, and for couplings were also agreed upon.

Presumably the full report of the committee will be published in early issues of the journals of the two water-works associations.

Railroad Line Change in the Tehachapi Pass

Two Troublesome Tunnels Eliminated at Less Than Concreting Costs—Portal Collapses as Bench Cut Is Substituted

THE single track railroad over the Tehachapi Pass in California presents operating difficulties far out of proportation to the mileage because of the grades, curves and tunnels that are combined there. Numerous studies have been made in the endeavor to find means of increasing the capacity of the line, in an operating sense, and decreasing the danger of blockades, particularly those due to trouble in the tunnels. Ten of the eighteen Tehachapi tunnels have been lined with concrete and concreting is being carried on continuously. Two of the tunnels, 12 and 13, that have been particularly troublesome have recently been eliminated by a line relocation that was carried out at a cost less than that of enlarging the tunnels to the company's present standard size and lining them with concrete. Despite a difficult situation that arose where the new location cut into the portal of tunnel 13, the new line was put into service practically without interruption to traffic.



RELOCATON OF RAILROAD LINE IN TEHACHAPI PASS

In studying the line change on paper and on the ground, it was decided that 2,700 ft. of new roadbed could be located so as to substitute open cuts for tunnels 12 and 13 by excavating a total of 90,000 cu.yd. This involved one through and one bench cut and two fills.

The Tehachapi grade, as a whole, is located on an uncompensated grade of 2.2 per cent which brings the equivalent compensated gradient up to 2.6 per cent on curves. The relocated line has a gradient of 2.5 per cent compensated or a slight improvement over the previous gradient. In addition to the 2,700 ft. of relocated line a length of 1,175 ft. of existing line at the west end was reballasted and the track raised to gain a 1.4-ft. grade rise.

The most serious problem was to get safely by the portal of tunnel 13 at the east end of the deep cut without any interruption to traffic. Here the bench cut would take away the material on one side of the tunnel timbering in heavy ground and hence was expected to threaten the stability of the tunnel. Excavation was started at this end of the line but with the first operation of the steam shovel along-side the portal, the tunnel timbers moved outward 1 inch. Work was promptly stopped and begun at the other end, the entire cut being made by advancing from that direction. This cut has a maximum depth of 75 ft. on the center line and 125 ft. at the upper edge of the slope.

As the cut approached the critical point opposite the portal, the excavated material was all used to widen the new bench at this point to make room for a temporary shoo-fly which was to be used pending the completion of the cut to final location. In widening the roadbed here the material had to build up a height of 125 ft. from the bottom of the existing slope, hence a large quantity of material was required to increase the roadbed width sufficiently. Material that might have been dumped elsewhere was taken to this point so as to insure having a bench wide enough for the shoo-fly at as early a stage of the work as possible in case an emergency should require its early use.

When the cut came near enough to the tunnel timbers so that they began to move, excavation was continued cautiously, rushing the filling where the shoo-fly was to be laid and making hourly observations on the tunnel timbers so as to have warning of danger to trains. When the timber movement was sufficient to impair clearance the tunnel was pronounced unsafe for trains, the line was closed to traffic, rails in the tunnel portal were taken up and the steam shovel in the cut was then worked at maximum speed, regardless of effect on the tunnel itself.

Within 5 hours after traffic through the tunnel had been stopped, the portal had collapsed and the shoo-fly had been opened to traffic. The collapse of the portal was a slow movement better described as a crushing down of the timbers. At the end of several days the timbering in the abandoned tunnel had caved in for a distance of about 100 ft. back from the portal.

Overflow Channels Proposed for Pueblo Flood Protection

Plan Involves Diversion of River to Bluff Side, an Overflow Channel, and Use of Railroad Yards for Extreme Flow

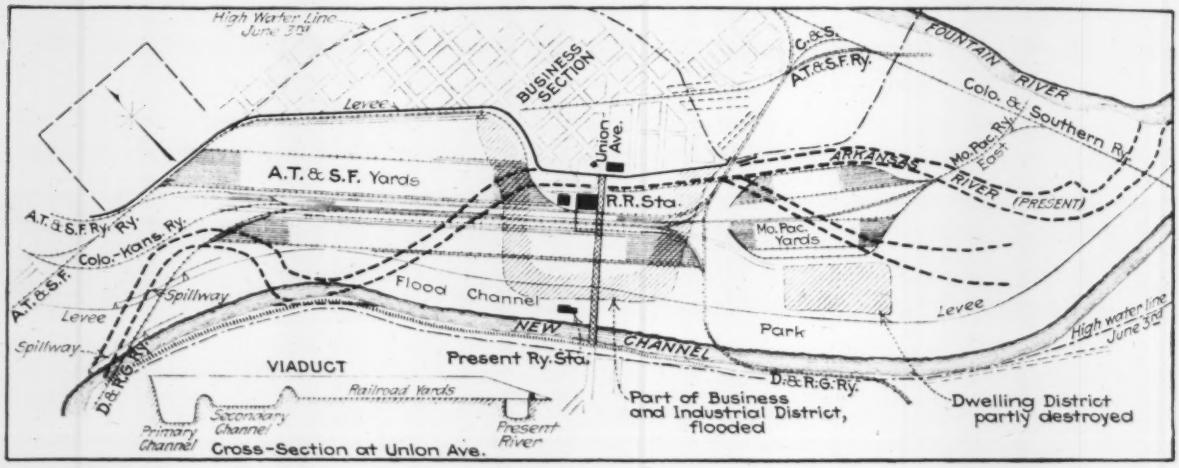
A NOTEWORTHY proposal for the control of the Arkansas River at Pueblo, Colo., to prevent recurrence of floods like that of the first week of June, has been put forward by Edward F. Rizer, civil engineer, of Pueblo. It depends upon provision of an overflow channel alongside the normal river channel, normally utilized as a park. This channel would make the capacity equal to the estimated flow of the 1921 flood. To provide for still higher floods, 50 per cent greater than that of June, a wide belt of level ground, adjoining the overflow channel and in the plan assigned to railroad yard use, is made to serve as a secondary overflow channel, carrying water 4½ ft. deep in extreme floods. Levees provided with suitable spillways separate the river and the overflow channels from each other.

In applying this flood control system to the Pueblo conditions, Mr. Rizer makes a relocation of the Arkansas River through the entire length of the city, shifting it from its present location (about the middle of the valley bottom) to the southerly edge, along the bluff. Complete revision of the railroad yards now occupying the south half of the valley bottom, would be required, as well as elimination of a business and industrial district lying between the present river and the Union Depot, and a housing district. In the accompanying plan of the project, the present river channel is indicated by dash lines. A section across the valley shows the proposed channels and the railroad yard district in profile.

Pueblo's physical location will continue to invite flood disasters, says Mr. Rizer in explaining his proposal, on account of the size, arrangement and steep slope of its drainage area, which make the river flashy. Three extreme floods have occurred within a 30-year period, in each case doing large damage. By moving the river south against the bluff, one bank is secured; the bluff is of blue shale and will not require revetment. Taking the ordinary flood volume at 65,000 cu.ft. proposed new channel is planned to be able to carry this flow. The "flood channel park," about 400 ft. wide, along the north bank of the new river channel, would receive water over a spillway at a point near where the river enters the city, increasing the capacity to 115,000 sec.-ft. The area north of this channel, to the present river, would be devoted wholly to railroad yards and would be kept available for peak flood flow, giving a total flow width of about 2,200 ft. The main part of the city to the north would be separated from the railroad yards by a retaining wall. Communication between this part of the city and the district lying on the south bluffs would be by viaducts like the one shown for Union Avenue.

This plan was developed on the assumption that Pueblo alone would have to finance the flood-protection work, and correspondingly it gives protection to the city only. Should the Arkansas Valley as a whole be included in the project, a detention reservoir would have to be added to the local channel improvement. This would, roughly, double the cost, it is stated.

Enlargement of the channel at its present location, Mr. Rizer says, would destroy more property value than the diversion project. That part of the plan involving rearrangement of the railroad yards is also logical as the present yards are poorly arranged and of inadequate capacity.



OVERFLOW CHANNELS FOR PROTECTION AGAINST ARKANSAS RIVER FLOODS AT PUEBLO
Railroad yards to serve as secondary flood channel.

Roadmen's Wages in Britain

The wages of men employed on roadwork in and about London average just over £4 per week. In some boroughs reductions are taking place, notably in Southwark, where a 3s. 9d. bonus has been withdrawn on account of the decreased cost of living. This brings the wages of roadmen and scavengers down from £4 11s. 11d. to £4 8s. 2d. per week. Men employed on improvement works have had an additional reduction of 2d. per hour.

	Wages per Hour	
	1920	1921
Ross and Cromarty	10d. to 1s. 3d.	9d. to 1s. 2d.
North Isles	8d.	7d.
Inverness	9d.	9d.
Orkney	1s.	10d.
Shetland	11½d.	10½d.

The wages paid to the same class of laborers in the north of Scotland work out as given in the table.

Removal of Colloids from Sewage: Theory and Practice

By Waldo S. Coulter
Consulting Engineer, New York City

Ever since Dr. William Owen Travis formulated his "Hampton doctrine," in which unusual emphasis was laid upon the part played by physical operations in the treatment of sewage, a more or less sustained interest has been shown by engineers in the removal of colloids. One does not have to accept the Hampton doctrine in toto to admit the importance of colloids and the desirability of removing them, even in part, if this can be accomplished in an economical manner.

Dr. Wolfgang Ostwald, defining colloids, says: "The colloids differ from the coarse dispersions in that they cannot be analyzed microscopically and in that they pass through ordinary filters. The colloids differ from molecularly dispersed systems in that they do not diffuse and do not dialyze, which molecular solutions do." Ostwald attempts to set limiting sizes for coarse dispersions, colloids and molecular dispersoids. For the purposes of this article, however, it will be sufficient to define colloids in sewage as matter in an extremely fine state of subdivision, down to the border line of solution. Such matter is practically unaffected by sedimentation, within any reasonable period, although probably reduced somewhat in septic tanks and to a larger degree by chemical precipitation.

Metcalf and Eddy illustrate its amount in a general way by a hypothetical effluent from a sedimentation tank, as follows:

Settleable solids	15 parts per million
Suspended colloids	150 parts per million
Dissolved colloids	50 parts per million
Total settleable and colloidal solids	215 parts per million

Colloidal Coagulation

Dr. Travis observed that colloids were coagulated by surface attraction or adsorption, either upon the surfaces of the vessel containing the sewage, or upon rods, etc., immersed in the latter. He states: "The value of presenting a larger extent of surface to the liquid cannot be exaggerated, for it not only causes increased deposition, but also shortens, in inverse ratio to the areas of the surfaces, the period during which the phenomena described are observable." Or, to again quote Ostwald, "We may regard adsorption as that change in concentration which colloids and other dispersed systems suffer at the surfaces where they come in contact with other bodies. . . . In cases of positive adsorption there commonly occurs a fixation of the colloid or of the dispersed material upon the . . . adsorbing surface. Under such circumstances, the rest of the dispersed system may be poured off without carrying away with it the dispersed material that has collected in the surface." Referring to the use of powders of carbon, Fuller's earth, etc., in adsorption experiments, Ostwald says: "The enormity of the adsorbing surfaces in such dispersed systems is not generally appreciated, nor how these may grow with increase in the division of the particles. To illustrate the matter I append the table given herewith which shows the surface increase of one cubic centimeter when undergoing decimal division."

INCREASE IN SURFACE OF A CUBE WHEN DECIMALLY DIVIDED*

Length of Cube Edge	Number of Cubes	Total Surface
1 cm.	1	6 sq.cm.
1 mm.	10^3	60 sq.cm.
0.1 mm.	10^6	600 sq.cm.
0.01 mm.	10^9	6,000 sq.cm.
1 micron	10^{12}	6 sq.cm.

*Table carried only to 1 micron; Ostwald's table more extensive—W.S.C.

To illustrate the adsorptive action of coarse suspended matters, he continues (Lecture on The Changes in State of Colloids):

> I want now to show you the wide distribution of these adsorption phenomena (demonstration). I have here a number of flasks filled with differently colored colloid and molecularly dispersed liquids; picric acid, iron chlorid, fuchsin, berlin blue, congo red, colloid silver, colloid gold, and colloid graphite. Standing opposite is an equal number of flasks, each containing a spoonful or two of bone charcoal (bone black). I pour upon the bone black in each of the flasks the contents of the flask opposite it and for a moment shake every mixture vigorously. I next pour all the mixtures, along with their bone black, one after the other into this large filter-lined funnel. In spite of the fact that I have carried out this whole procedure as rapidly as possible, you see that the filtrate runs through entirely clear. Adsorption has, in other words, occurred with extraordinary rapidity in all these cases and is practically complete.

To demonstrate that not only colored dispersoids and not only charcoal show such prompt adsorptive effects, he then proceeds to secure similar results with Fuller's earth and quinin solution. The same thing could have been done with sand in place of Fuller's earth, but the time would have been greatly prolonged, owing to the lesser aggregate adsorptive area of the sand particles.

In any practical application of this idea to the clarification of sewage, the time of contact and the aggregate area of the surfaces of adsorption, necessary for satisfactory results, must be within economical limits.

Colloid Deposition Slow

The deposition of colloids upon the inside faces of a glass container is usually a slow process. By greatly increasing the area of the exposed surfaces, a point will be reached where a considerable removal can be effected in a reasonable length of time, say four or five hours.

To secure the necessary adsorption surface by a multiplication of artificial faces, as rods, slabs, laths and the like, and to further place these so that the accumulation on their faces will detach itself readily, and the whole act without interference from scum, gas bubbles, etc., is not a simple matter. Nor is that of cost. For these reasons, colloiders have received little attention from American engineers.

In 1911 I visited the 39th St. Sewage Testing Station of the Sanitary District of Chicago. Among the features of this station was a small upward-flow tank of the type installed at the experimental plant of the Massachusetts Institute of Technology by Winslow and Phelps, known as the Boston biolytic tank. This is simply a Dortmund tank, with a steeply sloping hopper-shaped bottom and peripheral effluent gutter, but it differs from the Dortmund in that the influent pipe extends downward to a point just above the tank bottom, in such manner that the upward-moving sewage must pass through the sludge accumulation. If the

velocity of inflow is slight, or if the tank bottom is flat, flotation of the sludge accumulation may not take place. But with sufficient velocities in the lower portion of the tank the sewage will pass upward through a heavy flocculent mass of suspended sludge. The velocity in the upper part of the tank is, of course, reduced sufficiently to prevent the escape of sludge and suspended matters, except as this may occur through disturbances due to septic action. A scum baffle should be used.

The effluent of the tank at Chicago was remarkably clear. I had never seen anything from a clarification device that equaled it. Unfortunately it was heavily charged with hydrogen sulphide, and the vicinity of the tank was not a pleasant resting place. None of the other devices, handling similar sewage, showed this peculiarity. The remarkable clarity of the effluent from this biolytic tank attracted general attention. No satisfactory reason could, however, be assigned for it. Its predecessor at Boston had produced no such effluent; also, fortunately, no such gas.

Upon thinking the matter over afterward, it occurred to me that this extraordinary clarification might be due to a colloidor-like action of the sludge particles. The aggregate area of a mass of sludge particles must be enormous, much greater than it would be practical to provide by artificial surfaces. These particles were brought into intimate and prolonged contact with the colloids and, in comparison with the latter, the individual particles were massive. As for the tank at Boston, that was so large in comparison with the inflow that, at a point 2 ft. above the bottom, the mean velocity of upward flow was only slightly in excess of 2 ft. per hour. Under these conditions, it is not probable that any appreciable flotation of the sludge took place. Of course the designers had no colloidor action in mind when the tank was designed, and I do not mean to impute faulty arrangement.

Such tanks have since been constructed at activated-sludge plants to clarify the effluent from aëration tanks. In such cases the colloidor effect would not be noticeable, since colloids are pretty thoroughly removed in the aëration unit.

Early Use of Sludge Mixing

The commingling of sludge with inflowing sewage to secure a better clarification is an old idea. The Candy upward flow tank was in use in England before any attention was given to colloids by engineers. I have no information concerning the results secured with this tank, but they could not have been at all unusual, as the bottom of the tank was flat, and the sewage admitted from the side radially across the floor. Sludge was removed by a rotating arm delivering to a sludge pipe at the center.

A more intelligent application of the idea was the introduction of fresh sewage into a fill-and-draw tank containing old sludge. The whole was then agitated by compressed air, which dispersed the sludge throughout the liquid. This agitation was maintained for an hour or so. As chemicals were used, the process was chemical precipitation, with preliminary agitation. There is nothing to indicate what might have been the effect had the chemicals been omitted. It is said that the process showed little or no improvement over straight chemical precipitation with adequate preliminary mixing in baffled channels. It is interesting to note how closely this old Mather & Platt process unwittingly approached the activated-sludge process.

The adsorption surfaces presented by the media of contact beds and sprinkling filters no doubt act as colloidors, especially in the case of contact beds, where the sewage is retained for a longer period.

Finally the action of the dispersed sludge particles in the aëration tank of an activated-sludge plant have, in my opinion, much to do with the excellent clarification secured, their action being a physical one. I am not, of course, denying the oxygenic work of bacteria.

The scrubbing or straining action of the sludge in biolytic tanks following aëration chambers is sometimes referred to. I am convinced that where it is used elsewhere, as it has been, I understand, by Robert Spurr Weston, for certain industrial wastes, it acts to a marked degree as a colloidor.

If this is correct, we are able to secure a colloidor, to some degree at least, without resorting to chemicals or pulverized materials, or to costly and difficult arrangements of artificial surfaces.

Practical Applications

I have installed two plants along these lines. One treats the waste from a millboard factory and the other an institutional sewage. Considerable colloidal matter remains in the effluent from the former, but the clarification is good, with a very important removal of colloids. Quiescent sedimentation of the raw waste in a tall beaker glass has no effect upon a large part of the finely divided solids, unless prolonged to an impractical period. The test plant which preceded the operative installation showed an average removal of 60 to 80 per cent of suspended solids. This does not appear at all remarkable until the effluent is compared with a sample subjected to quiescent sedimentation for a like period. As regards the institutional plant, only a few persons have as yet been served by the tank, so that the retention period is abnormally long and the velocities in the lower portion of the tank correspondingly low. While the effluent is excellent, it has not as yet been any better than the effluent from any good tank might be.

The instances alluded to above do not, in themselves, make a case, I admit. Nevertheless they do, in connection with the other facts referred to, indicate, I believe, a probability that the particles of sludge accumulation may be made to act as colloidors if the tank is properly designed. The presence of excessive quantities of hydrogen sulphide in the effluent from the Chigo tank may perhaps be taken to confirm Dunbar's suggestion that most of the sulphur compounds in sewage are in the colloidal matter, and that the removal and reduction of the latter under other than aërobic conditions will be offensive. This may, upon more extended practice, prove to be the case, but I think that most authorities in colloid chemistry are agreed that there is no selective action in the formation of colloids, based upon chemical composition, but that, as Von Weimarn says, "The colloid state is a universally possible state of matter." As regards varying consistency of sewage matters, it is doubtless true that some are more readily macerated and dispersed than others, yet I think it remains to be demonstrated that sulphur compounds predominate in such matters.

The retention period should not be long enough to

permit too vigorous septic action. The incoming sewage generally contains some oxygen as it passes into the sludge.

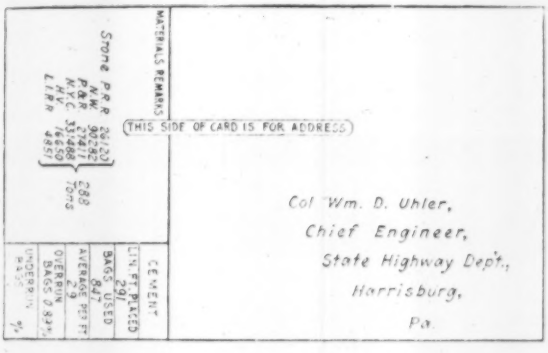
The digestive action of tanks of this type is good, but the sludge has a high moisture content, which is a drawback. This last difficulty might be overcome by a separate digestion tank.

The upward-flow tank will unload to a greater degree, perhaps, than any other single-story tank, despite any combination of baffles. I have found that a short-period two-story tank, following the colloidor, will redeposit and retain most of the matter unloaded, if the colloidor effluent flows over a weir or is otherwise somewhat agitated to release entrained gases.

Daily Road Construction Report Card, Pennsylvania

INSPECTORS of highway construction in Pennsylvania make daily reports of progress on the convenient post-card form shown by the accompanying drawing. Two copies of this card are mailed, one to the chief engineer and one to the district engineer of the state highway department. The illustration indicates the information reported.

In making these reports the inspectors are required to exercise great care in charging all time to the item



	NUMBERS OF EACH		13		43	142	7	205		9	10	1	3	3	WEATHER Fair TEMP. Warm
	COUNTY Dauphin DATE 9-3-1919 SUPT.		FOREMAN	ENGINEER	SKILLED LABORER	COMMON LABORER	CARPENTERS	TOTAL MEN		TRUCK	TEAM	S. SHOVEL	ROLLER	MIXER	OFFICIAL INSPECTION Mr. T. C. Frame
															PROGRESS Fair
															STATIONS
	GRADING		45		90	660	20				90	10	30		398+00 – 473+00 475 – 545 – 647
	BASE		10		15	40									"
	SURFACE		25		230	400	20			80				20	" 463+15 – 468+15 548+10 – 550+85
	DRAINAGE		40		20	260								10	"
	MISCELLANEOUS		10		70	60	30			10	10				"
	TOTAL HRS.		130		430	1420	70	2050		90	100	10	30	30	B. F. Smith INSP.

INSPECTORS' DAILY REPORT POSTCARD IN USE BY PENNSYLVANIA HIGHWAY DEPT.

to which the cost ultimately applies. In general, accuracy is demanded in all information reported and entries under the head "miscellaneous" are rigidly restricted. The cards are filled out from the inspector's note book, which is kept in a prescribed form and with great accuracy, since it becomes, when finished, an original record in the files of the Pennsylvania State Highway Department.

Engine Driver Describes First Trip of Passenger Train in 1831

OPERATION of the first passenger train locomotive in the United States and a brief account of contemporary locomotive building is contained in a letter to C. C. Hopkins, consulting engineer, Rochester, N. Y., written in 1890 by David Matthew, the engineer who drove the locomotive "DeWitt Clinton" on its first trip. Through the courtesy of Mr. Hopkins, Mr. Matthew's letter is printed herewith and is thought to be a matter of timely interest in view of the recent refitting and actual runs of the old "DeWitt Clinton" as reconstituted by the New York Central R.R. The letter is dated from San Francisco, Oct. 20, 1890, when the writer was about 90 years of age:

Yours of Oct. 4th, inst. was duly received and contents noted. You requested me, as engineer of the Locomotive Engine "Dewitt Clinton," to give an account of the running of the first passenger train, on the American continent.

As you have become educated to the locomotive engine as a big Iron Horse, of weight, varying from 30 to 50 tons or more, I must take you back to the days when the locomotive was a colt. His body was light, and the wheels were made of rods of iron, turned and finished and bright. The suspension wheels were braced by rods, similar to those of the wheels of the bicycle of today, equally as well finished. In fact the locomotive of that period was as like a thing of life and speed, compared with the present locomotive, as a grey hound is to the present horse or bull dog.

Every thing was light, neat, and made of the best material, like clock work. The weight did not exceed three and a half tons, without tender. The tender was not made at shop, but at Albany, after the engine was on the road. Here was the first application of the outside journals, on the railroad axles, which were put under the "Dewitt Clinton's" tender. The coaches had shafts with inside bearings and wheels outside of the frames, while the "Dewitt Clinton's" tender was outside. The stage coaches' bodies were mounted on light wheels, etc., everything being light, to keep down non paying weight.

The starting point of the first passenger train, was at the junction of the railroad and Cherry Valley turnpike, two miles from state house, of Albany, N. Y. Thousands of people had assembled to witness the starting. I had been there from the 27th of June to the 9th of August, fitting up and experimenting with fuel, etc. The road over which we were to pass, was good and smooth and straight for the greater part of the way. With our light smooth colt and cars, we were ready to take our load of passengers, and commence our flight with the birds, that wished to join us in our trip over broad miles to the Mohawk. Our engine wheels, springs, etc. were very bright, and when in motion, reflected the rays of the sun, like a mirror—which was very novel and interesting to me, at that time.

I am informed that a pair of the "Dewitt Clinton's" wheels are on exhibition at the Grand Central Station, New York City. The "Dewitt Clinton"—Locomotive Engine—that is, the boiler, cylinder, crank shaft with driving wheels, etc., was sold to a man who put them in a small boat to tow canal boats about Troy and Waterford, in 1833. Thus the back wheels and shaft, which were left, are to be found at the Grand Central Depot, N. Y. City. The diameter of the suspension wheels was 4½ feet. They were bright, had finished arms, and the hub was covered with brass plates, on which was engraved, W. P. F. Association [West Point Foundry Association]. So you can see what the Locomotive, or Iron Horse was when a colt. You have never seen the old mare run away from her colt.

Note on Locomotives.—In May 1829 the "Strowbridge Lion" was landed at W. P. F. A. N. Y. City, and was there exhibited to thousands, under steam, blocked up, to allow her wheels to turn without the body moving.

In 1830, the Locomotive "Best Friend of Charleston" was built at W. P. F. A., N. Y. City, for South Carolina R.R.; also the Locomotive "West Point" for the same road. Both

were exhibited under steam at the shop before shipping them to Carolina. No tender had been made for either of these. Next in turn, came the "Dewitt Clinton." The two preceding ones were used for the road construction, and running excursion trains, and not used in passenger traffic. So that makes the "Dewitt Clinton"' the Pioneer Locomotive on the passenger traffic, and I, the Man that had the head charge of building and exhibiting the three first Locomotives under steam, and of running the first passenger train on the American Continent. I have drawn out a home spun, illustrated History for my Boys, that they may have their own History.

Our Rail Road men are so taken up with foreign stock that they lose sight of their own country.

Notes.

J. T. Clark was the man that collected first passenger fare, on train drawn by locomotive engine, in America.

J. V. Jervis was orderer of the first Locomotive engine for America, for RailRoad service, 1828.

E. L. Miller orderer of "Best Friend"—1830.

H. Allen, orderer of "West Point" winter of 1830 and 31.

J. B. Jervis, orderer of "Dewitt Clinton"—1831, on road, June 1831. Three first to do business in America, on Rail Road, Wooden wheels on first three, "Strowbridge Lion," "Best Friend," and "West Point."

Mr. Hopkins says: "He [David Matthew] was an experienced mechanic, having served nearly five years as an apprentice in the steam engine factory of the West Point Foundry Association, and by a resolution of the board of directors of the Utica & Schenectady Railway Co., passed Sept. 23, 1835, was employed by that railroad as chief locomotive engineer and machinist, his employment commencing Jan. 1, 1836. He also worked in the U. S. Government workshops in the Navy Yard at Washington, D. C."

Machines for Railway Track Work

That labor-saving machinery is coming into use more extensively in connection with track work was a view expressed emphatically by C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry., in an address at the recent annual convention of the Roadmasters' and Maintenance of Way Association. The following is an abstract of his remarks on this point:

With labor-saving machinery coming into use more and more in connection with track work we need to keep in mind that it is purchased to save labor and money, and that with it our requirements for labor should be reduced. A man to the mile was the force that was considered necessary in the old days. If you ask roadmasters today how many men they needed to properly handle the work, nine out of ten would tell you they ought to average a man to the mile; this even on roads using treated ties where but half the number of ties have to be inserted per year and provided with ditching machines, modern steel spreaders, center dump ballast cars, air dump ditcher cars, motor cars with mowing machine and shoulder weed cleaners, tamping machines and various other labor-saving devices. What we need to do is to take account of stock and revise our ideas of the force necessary to maintain track, where machinery has been furnished.

As a word of advice: Have patience with any new device that is sent you. Your first tendency may be to say that it is no good, and to set it off the track and continue in your old methods. But remember that the machine would not have been furnished you if someone had not made a success in its use and shown that it would save money. So when you say you cannot use it to advantage you are admitting at once that you cannot do what some other man has done in the way of saving money in doing your work; in other words, that you are not as good a man as the other fellow. Therefore, have patience in learning how to operate a machine and if you cannot get results from it ask that someone be sent out to instruct you in its use.

Testing and Calculating Aluminum Sulphate Solutions

BY CHARLES H. CAPEN, JR.
Assistant Sanitary Engineer, State Department of Health, Trenton, N. J.

A METHOD for readily checking the amount of aluminum sulphate applied to a given water supply has recently been devised, utilizing charts for the calculation in which specific gravity and rates of flow alone are used to compute the alum feed. So far as known no satisfactory field titration for alum solutions has yet been found. With the following procedure titration is unnecessary.

A sample of the alum solution is collected in a cylinder of known volume at a point as near as possible to the place of application, the length of time required to fill the cylinder being taken with a stop watch. At some plants where it is impossible to measure the rate of flow in this manner, the total amount of solution used per day may be found by measuring the volume of the solution tank and assuming the rate to be a constant throughout the day. A specific gravity hydrometer is then placed in the cylinder and after correcting the reading for temperature the per cent of alum in the solution can be determined from the curve made for that purpose. With these data and the rate of flow of the treated water, the alum dose in pounds per day and grains per gallon may be obtained from the chart.

The formulas from which the chart was plotted were developed as follows:

Let T = temperature of alum solution in deg. F.;
S = specific gravity hydrometer reading;
S' = specific gravity corrected for temperature above or below 60 deg. F.;
P = per cent (by weight) of alum in solution;
A = alum flow (c.c. per sec. or cu.ft. per day);
L = pounds of alum per day;
F = water flow (million gallons per day);
G = grains per gallon of alum applied to water;
j and k = constants.

By experiment (1) $S' = S + 0.0002\ (T - 60)$
(2) $P = 190\ (S' - 1)$

Then since the pounds of alum per day vary directly as the per cent and rate of flow of the solution

$$(3)\quad L = jAP = \frac{(60)\ (60)\ (24)\ (0.0022046)}{100} AP \therefore$$

$j = 1.90477.$

Since the grains per gallon vary directly as the pounds of alum per day and inversely as the rate of flow of water receiving treatment

$$(4)\quad G = k\frac{L}{F} = \frac{1}{(8.345)\ (17.142)}\frac{L}{F} \therefore\ k = 0.0069906$$

Place L of (3) in (4) then (5) $G = jk\dfrac{AP}{F}$ $jk = 0.013315$

Place P of (2) in (5) then (6) $G = 2.5294\dfrac{A(S' - 1)}{F}$

Alum solutions of various percentages of strength were made up from commercial alum and their specific gravities taken at a uniform temperature of 60 deg. F. The correction for variations in temperature was also determined. This correction is not absolutely constant for all hydrometers but the variation may be neglected.

An error is introduced into these computations by assuming in equation (3) for computing the value of

that the weight 1 c.c. of the alum solution is 1 gram or 0.0022046 lb. This error in per cent is measured by the equation $E' = 100\ (S' - 1)$. The normal range of this error has been found to be from 0.5 per cent to 2 per cent. This error may be disregarded for the reason that compensating errors are introduced in collecting the alum sample, reading the hydrometer, measuring the rate of water flow, etc. Example:

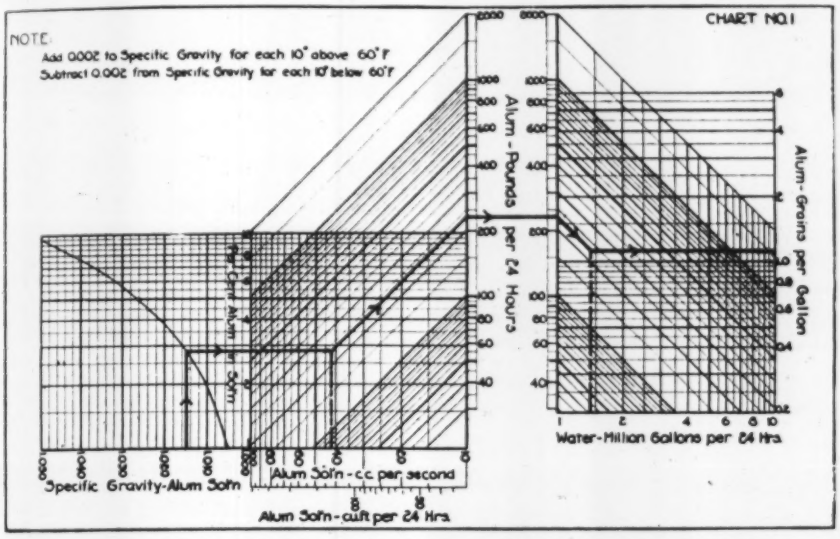


CHART NO.1
NOTE:
Add 0.002 to Specific Gravity for each 10° above 60° F
Subtract 0.002 from Specific Gravity for each 10° below 60° F
Alum - Pounds per 24 Hours
Alum - Grains per Gallon
Water - Million Gallons per 24 Hrs.
Specific Gravity - Alum Soln
Alum Soln - c.c. per second
Alum Soln - cu.ft per 24 Hrs.

ALUM FEED CHART BASED ON SPECIFIC GRAVITY AND SOLUTION FLOW PER SECOND

Given $S = 1.013$ $T = 70$ $A = 42$ $F = 1.4$
Find P, L and G
Correcting for temperature $S' = 1.015$
From chart (1) (see heavy lines),
$P = 2.8$, $L = 230$, $G = 1.2$
From formulas (2, 3 and 6),
$P = 2.85$, $L = 228$, $G = 1.14$

Similar charts to obtain quickly the rates of hypo feed have been made up, utilizing the regular sodium thiosulphate titration for obtaining the strength of the solution. Some charts which involve portions of these principles are given in "Water Purification Plants and their Operation," by Milton F. Stein, and some parts of the formulas are given in the *Manual* of the American Steel Wire Co.'s "System of Water Purification," by C. Arthur Brown, but the computations are not reduced to a minimum in either case. The methods described in this article, together with small notebook sized copies of the charts, have actually been used in the field a great many times and have proved very satisfactory.

Second Simplon Tunnel Nearing Completion

Completion of the second Simplon tunnel may be expected by early fall, according to progress reports just published. At the end of April the length of completed (and fully lined) tunnel was 19,408 m., out of a total length portal to portal of 19,825 m. Full-section excavation has proceeded about 150 m. farther. A monthly progress of about 100 m. is being recorded, so that September or October should see final completion of the enterprise. This second tunnel is an enlargement of the pioneer heading constructed at the time the first tunnel was built.

Manganese Bronze for Water-Works Valve Stems

By William R. Conard
Inspecting Engineer, Burlington, N. J.

Of the thirteen or more parts in a water-works valve the stem is the most important, for upon it depends the proper opening and closing of the gate or gates and the operation of the wedging mechanism, which in turn controls the flow of water, and if the stem fails the rest of the mechanism is useless. In determining the diameter of the stem the area at the base of the thread should control and not the full diameter of the stem, and high factors of safety should be allowed to provide not only for these stresses but also for the human element, which always enters into the operation of a device of this kind.

After giving the matter extended study I have concluded that the best bronze for valve stems is that having a high yield or elastic limit, moderate ductility, and a high ultimate strength, but not more than 100 per cent higher than the yield point. Fortunately this can be done at practically no increase in cost. It is not particularly difficult to get a bronze that will have a yield point of not less than 40,000 lb. per square inch, an ultimate strength of 60,000 to 70,000 lb. per square inch, an elongation percentage of 10 in 2 in., and a reduced area percentage of 10. It may be noted in passing that the water-works official and the manufacturer usually base their calculations on the ultimate strength of the material, figuring that the usefulness of the stem is not gone until it actually fails, overlooking the importance of having the stem retain its original shape.

This harder, stronger metal is of course somewhat tougher and not quite so easily machined, but if the proper tools are used it does not appreciably increase the cost, and surely is better than increasing the size of the stem beyond the manufacturers standard to get the added strength.

The more frequent reasons for valve stem failures are that the necessary strength is mostly based on the full diameter of the stem; the tensile or ultimate strength of the metal, and not taking into account that metals of any kind unless especially treated for it do not have as great a strength in the center or core of the mass as near the surface, with the result that a stem has scarcely any greater strength at the bottom of the thread than the simple working stresses that are put on it, without taking into account added friction due to corrosion, sediment, etc., nor that in many cases the persons operating are likely to use tools that exert considerably greater leverage on the gears or operating nut than is intended or needed.

Test pieces should be cast attached to the actual stem where possible and where the small size of the stem will not permit this, then the test piece should be cast in the same heat and in the same flask as the stems. In the case of hammered or forged stems the test piece should be a prolongation of one end of the stem reduced to a cross-section that will show a close approximate of the metal in the stem itself.

Stems for valves 30 in. and more in size should be of forged manganese bronze. Forging adds very little to the cost and adds somewhat to the physical qualities, but its main value lies in making the metal homogeneous, perfect for threads, free from the dangers due to the different cooling stresses common in the inner and outer portions of castings.

Conference Suggests Plan for Unemployment Relief

Private and Public-Works Construction Affords Greatest Field for Taking on Men Now Out of Work

CONSTRUCTION, both public and private, is held up by the President's Unemployment Conference as the greatest field for employment at the present time, and every interest concerned is urged to undertake such works. This forms one of the recommendations for emergency relief adopted by the conference previous to its adjournment Sept. 30 to meet again Oct. 10 to take up permanent measures to prevent the recurrence of unemployment periods.

The recommendations, twelve in number, lay down a standard procedure, urge in detail the resumption of certain classes of work and purpose measures for relief applicable to manufacturing establishments.

Methods of Procedure

1. The Conference finds that there are, variously estimated from 3,500,000 to 5,500,000 unemployed, and there is a much greater number dependent upon them. There has been an improvement, but pending general trade revival this crisis in unemployment cannot be met without definite and positive organization of the country.

2. The problem of meeting the emergency of unemployment is primarily a community problem. The responsibility for leadership is with the mayor and should be immediately assumed by him.

3. The basis of organization should be an Emergency Committee representing the various elements in the community. This committee should develop and carry through a community plan for meeting the emergency, using existing agencies and local groups as far as practicable. One immediate step should be to co-ordinate and establish efficient public employment agencies and to register all those desiring work. It should co-ordinate the work of the various charitable institutions. Registration for relief should be entirely separate from that for employment.

4. The personnel of the employment agencies should be selected with consideration to fitness only and should be directed to find the right job for the right man and should actively canvass and organize the community for opportunities for employment. The registry for employment should be surrounded with safeguards and should give priority in employment to residents. Employers should give preference to the emergency employment agencies.

5. The emergency committees should regularly publish the numbers dependent upon them for employment and relief that the community may be appraised of its responsibility. Begging and unco-ordinated solicitation of funds should be prevented.

Classes of Work Urged

6. Private houses, hotels, offices, etc., can contribute to the situation by doing their repairs, cleaning, and alterations during the winter instead of waiting until spring, when employment will be more plentiful.

7. Public construction is better than relief. The municipalities should expand their school, street, sewage, repair work and public buildings to the fullest possible volume compatible with the existing circumstances. That existing circumstances are favorable is indicated by the fact that over $700,000,000 of municipal bonds, the largest amount in history, have been sold in 1921. Of these, 106,000,000 were sold by 333 municipalities in August. Municipalities should give short time employment the same as other employers.

8. The governor should unite all state agencies for support of the mayors and, as the superior officer, should insist upon the responsibility of city officials; should do everything compatible with circumstances in expedition of construction of roads, state buildings, etc.

9. The federal authorities, including the Federal Reserve Banks, should expedite the construction of public buildings and public works covered by existing appropriations.

10. A congressional appropriation for roads, together with state appropriations amounting to many tens of millions of dollars already made in expectation of and dependence on federal aid, would make available a large amount of employment.

The conference under existing circumstances, notwithstanding various opinions as to the character of the legislation and the necessity for economy, recommends congressional action at the present session in order that work may go forward.

11. The greatest area for immediate relief of unemployment is in the construction industry, which has been artificially restricted during and since the war. We are short more than a million homes; all kinds of building and construction are far behind national necessity. The Senate Committee on Reconstruction and Production, in March of this year, estimated the total construction shortage in the country at between ten and twenty billion dollars. Considering all branches of the construction industries more than two million people could be employed if construction were resumed. Undue cost and malignant combinations have made proper expansion impossible and contributed largely to this unemployment situation. In some places these matters have been cleaned up. In other places they have not and are an affront to public decency. In some places these things have not existed. In others costs have been adjusted. Some materials have been reduced in prices as much as can be expected. Where conditions have been righted, construction should proceed, but there is still a need of community action in provision of capital on terms that will encourage home building. Where the costs are still above the other economic levels of the community there should be searching inquiry and action in the situation. We recommend that the governors summon representative committees, with the co-operation of the mayors or otherwise as they may determine, to (a) determine facts; (b) to organize community action in securing adjustments in cost, including removal of freight discriminations, and clean-out campaigns against combinations, restrictions of effort, and unsound practices where they exist to the end that building may be fully resumed.

12. Manufacturers can contribute to relieve the present acute unemployment situation by

(a) Part time work, through reduced time or rotation of jobs.

(b) As far as possible, manufacturing for stock.

(c) Taking advantage of the present opportunity to do as much plant construction, repairs, and cleaning up as is possible, with the consequent transfer of many employees to other than their regular work.

(d) Reduction of the number of hours of labor per day.

(e) The reduction of the work week to a lower number of days during the present period of industrial depression.

(f) That employees and employers co-operate in putting these recommendations into effect.

A large number of employers have already, in whole or in part, inaugurated the recommendations herein set forth, and for this they are to be commended, and it is earnestly urged upon those employers who have not done so to put same into use, wherever practicable, at the earliest possible opportunity.

(g) Specific methods for solution of our economic problems will be effective only in so far as they are applied in a spirit of patriotic patience on the part of all our people.

During the period of drastic economic readjustment, through which we are now passing, the continued efforts of anyone to profit beyond the requirements of safe business practice or economic consistency should be condemned. One of the important obstacles to a resumption of normal business activity will be removed as prices reach replacement values in terms of efficient producing and distributing cost plus reasonable profit.

We, therefore, strongly urge all manufacturers and

wholesalers who may not yet have adopted this policy to do so, but it is essential to the success of these measures when put into effect that retail prices shall promptly and fairly reflect the price adjustment of the producer, manufacturer, and the wholesaler.

When these principles have been recognized and the recommendations complied with, we are confident that the public will increase their purchases, thereby increasing the operations of the mills, factories and transportation companies, and consequently reducing the number of unemployed.

Some Factors Affecting Zoning and Living Conditions

FACTORS affecting zoning and living conditions discussed by George B. Ford before the recent National City Planning Conference included an outline of observations on the distribution of industrial establishments and of business throughout a number of cities as observed by him and his associate, Ernest P. Goodrich, in their city planning studies; the number of stores to be allowed for a given population; the proportion of apartment houses and tenements found in various cities, and Mr. Ford's conception of the proper way of so controlling these as to serve the best interests of cities and their inhabitants. As to the latter phase of the subject, Mr. Ford urged that it was not so important to limit the number of families per acre as to control internal and external living conditions affecting the health, comfort and happiness of city dwellers. As to the distribution of industrial plants, Mr. Ford stated that in cities of 15,000 to 50,000 population industry is generally "concentrated in a rather small compact group"; in places of 75,000 to 150,000, industry is "spread in feelers along the railways and waterways"; while in larger cities the distribution of industry is generally quite irregular and haphazard, resulting in serious transportation and other problems.

Business Houses and Apartments

As to business houses in towns of 10,000 or less, they are generally found "concentrated in a small area in the center of the town at a cross-roads or spread along a single street"; in places of from 10,000 to 50,000 business extends out from the center of the city along a number of streets, while here and there there are stores "at convenient corners in the residential districts"; as cities grow in size from 50,000 population and upwards, business extends out in "long feelers" on the principal traffic streets. The number of stores found in a half a dozen cities investigated have ranged from one to forty to each 125 inhabitants, the ratio being relatively larger in the smaller communities. Mr. Ford suggests that for places of 25,000 inhabitants or less there should be one store to each 50 or 75 inhabitants; in places of 25,000 to 100,000 one store to 75 to 100 people, and in communities of more than 100,000, with department stores, one store to 150 people. Even in large cities the outlying districts would have to have stores provided much the same as in smaller communities.

Other than one-family houses are rarely found in communities of less than 10,000 population and tenement houses are rarely numerous until a place has attained a population of some 20,000, while apartment houses are "rarely prevalent in cities of less than 50,000 inhabitants or in metropolitan residential suburbs of less than 25,000 inhabitants. In the East we find that there is one tenement or apartment house to every 100,000 inhabitants."

On the subject of zoning limitations designed to prevent congestion Mr. Ford says:

Aside from possibly esthetics there is little that is wrong with the two-family house, the tenement or the apartment, except the tendency to inadequate light and air, undue congestion, lack of privacy and of a place for the children to play. If these four features can be taken care of properly there is little that is harmful about congestion so-called.

The solution of these problems lies not in the policy, so difficult of enforcement, of limiting the number of families per acre, which is a palliative, imported from England, but rather by providing adequate yards and courts and a reasonable amount of open space in front of each window, front, rear, side and interior. If this is done properly, undue congestion will be taken care of effectively by indirection.

On the other hand, if room congestion is taken care of in a zoning ordinance it should be done frankly in the same way it is done in the tenement house laws by limiting the number of square or cubic feet of air per person in living and sleeping rooms.

We have found that we get vastly more satisfactory results in a much simpler and more direct way by specifically stating the minimum sizes of front yards, side yards, rear yards and courts which must be increased in size as the building goes up in height and as the lot increases in size. If done properly it makes wider lots desirable and a better business proposition.

Provision For Yards

Similarly we find in practice that there is little or nothing gained by employing the cumbersome processes of limiting the percentage of lot occupied, for appropriate front, side and rear yard provisions solve the problems of securing adequate light and air and relieve over-crowding in a much simpler and more logical way.

Rather than limit the percentage of lot occupied we would recommend the more reasonable expedient which E. P. Goodrich has used in the Westfield, N. J., zoning ordinance where he made the front yards, the side yards and the rear yards each a certain minimum percentage of the area of the lot. We have applied this latter principle to at least 500 typical existing buildings and found that it works surprisingly well and causes no hardship.

In making city plans for Rheims, France, a place of 125,000 inhabitants before the war, which seemed destined to become an industrial center of 300,000 to 400,000 inhabitants, Mr. Ford provided for "an industrial sector along each of the five railways and three waterways radiating through the city." Alternating with these industrial sectors, the plan called for housing areas for wage-earners. On the southern hills provision was made for a high class residential development. The idea was that workingmen would be enabled to live near enough to their work so that they could walk to and from their homes morning, noon and night "without having to encumber the transit lines or to cross the center of the town." This plan also would give the workingmen quick access to "the outlying country, along a radial, without having to cross an industrial district."

Small playgrounds and parks attached to the schools were located in the dwelling sectors and larger recreational areas of the same sort were provided in outlying districts, together with market gardening areas. In the center of the city provision is made for the concentration of the general business and administration, while on the radial arteries and main cross thoroughfares in the residential sectors it is expected that local business houses will be established.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

World's Shaft Sinking Record

Sir—In the "Hints to Contractors" in your issue of Sept. 15 appears a paragraph on "Shaft Sinking Records." A new record has been set at the Water Lily shaft of the Chief Consolidated Mining Co., Eureka, Utah, where the Walter Fitch Jr. Co., the contractor, sunk 427½ ft. in 31 working days ending Aug. 15. This was described in *Engineering and Mining Journal*, Sept. 3. The equipment included four self-rotating hand-held air hammer drills.

Chicago, Sept. 19. SULLIVAN MACHINERY CO., S. B. KING.

[According to the *Engineering and Mining Journal* the shaft is vertical and has three compartments 4 ft. 4 in. x 4 ft. 6 in. Hoisting was done in two compartments by two small electric hoists with buckets of 17 cu.ft. capacity discharging by automatic dumps into cars of 18 cu.ft. capacity. The shaft timbers are 8 x 8 in. The first 367 ft. was in a porphyry formation which was favorable for mucking but offered difficulties in drilling on account of its sticky character. The last 60 ft. was in a moderately hard close-grained limestone. The sinking was done on a 3-shift basis with an average of 5.7 shaftmen per shift. Shaft sets were placed at the rate of 2.8 per day by an average of 4.8 lumbermen. The timber was installed from a suspended steel bulkhead which hung from the last set and made it possible to carry on timbering and mucking or drilling simultaneously. An average of 72.5 buckets of muck were hoisted each shift. For each round 23.9 holes were drilled, and the average powder consumption was 15¼ lb. of gelatine powder per foot. The average daily progress was 13.8 ft. During the 31-day period, shaft operations were delayed 13 hours on account of failure of powder and repairs to headframe. The men were paid the standard scale and a bonus which increased proportionately with the footage.—EDITOR.]

Running Cultural and Technical Studies in Parallel for Six Years

Sir — Prof. Burr's paper on engineering education is so sound in the main that it does not need to be supported by unnecessary depreciation of the status of the engineer.

The intelligence tests of the United States Army during the war indicated that the engineer officers had a higher average intelligence than any other calling represented in the army. Medical men fell very far below. As to financial status I have read that just before the war the average annual income of a medical doctor in the United States was about $1,500. In working with civic groups in many communities I have found the medical doctor as a rule (there are many exceptions) to be so engrossed in his private affairs that he does not stand out as notable for assuming civic and social responsibility, as compared with merchants and business men, many of whom lack his equipment of cultural education. His liberal education has not entirely saved him from provincialism and selfishness. The fact that the engineer is habitually more dissatisfied with himself than is the doctor does not necessarily reflect discredit on the engineer.

The lawyer's profession is that of dealing with human relations. His experience in that field gives him a tremendous advantage, not all of which is due to his liberal education, as note the many great successes of lawyers who have been admitted to the bar after apprenticeship in lawyers' offices and without the help of college educations. It should be borne in mind that while the medical and legal professions have dignity, vested rights, and prestige acquired gradually since before the days of Hippocrates and Justinian, the engineering profession is scarce a century old.

But granting the above, I believe it remains true, as Prof. Burr states, that the most outstanding limitation of the engineer is his frequent lack of the broad foundation of a general cultural education and outlook. Without such a foundation he may lack that capacity for an appraisal of relative values, and for a comprehensive outlook, which is essential preparation for any large part in economic and civic affairs. The strictly technical education of some engineering schools may in fact tend to inhibit the normal development of civic and social interests which would occur if given a chance. The next most important weakness in engineering education is the tendency to confine preparation to theoretical and laboratory study, leaving out those contacts with real situations which develop self reliance and initiative, and help the engineering student to discover his own characteristics as related to real life.

There is another method of accomplishing these results besides the recommendation by Prof. Burr, of having a cultural course followed by a professional course. This other method consists of carrying the two lines of preparation at the same time, for the same period of six years. This latter method has two chief advantages. First, there is now a failure of cultural and professional schools to realize their close relationship and interdependence. This realization can be developed when the two lines are carried together, and there can be elimination of duplication, as in teaching English or Physics to those who are to become engineers. Second, if the two lines of work are carried together, the student's mind can be growing in *both* fields during the whole six years. Education is not alone a matter of hours spent in class, but also a matter of the increase of mental comprehension, and time is a vital element in that process.

At Antioch College we are endeavoring to accomplish these various ends by methods described sometime since in *Engineering News-Record* (see issue of Jan. 20, 1921, p. 108). During a six-year course the student spends half his time at school and half at work. Of his school time, approximately half is spent with cultural studies and half with technical courses. Some courses, as English, Psychology, Physics, Chemistry and Mathematics, relate to both cultural and technical education, so duplication is avoided. At the beginning of the course the work is mostly in the cultural field. The student may arrive at his decision of a vocation gradually, after conferences and assistance. He may be in college a year or two before any vocational choice is made. If by the second year he should have decided upon the general field of engineering, some of his courses would relate to that general field, and, for instance, be made to include advanced physics and mathematics. As the years pass he will define his calling more definitely, and will take more specifically technical courses, and less cultural work, though both elements persist throughout the course. Vocational decisions commonly are made prematurely and without proper consideration. Young men and women do not have easily determined "bents" to the extent commonly supposed. The final choice of a vocation may well be postponed until the later college years, but it cannot safely be ignored in the meantime, as generally is the case in liberal colleges. It is one of the big problems of college years, to be given serious and continuous consideration.

There is perhaps an assumption in Prof. Burr's paper to the effect that the engineer has a certain definite function for which he requires certain definite preparation. This is not the case. Engineering is an undefinable field, and the engineer's work takes innumerable forms and such a range of magnitude that no one standard of preparation will apply. For instance, at Antioch we aim to train for proprietorship or management as related to engineering, industry or other callings. Only a carefully selected group, high in initiative and native intelligence, is suitable for such training. Another school may well train for more definitely technical and much more specialized fields, and give the maximum of service to students who by type must always be employees working under direction. Some men should receive the broad cultural training necessary to prepare

them for high professional standing and large responsibility, while with others specific technical training is all that society properly can afford to furnish. There should be numerous types of engineering education, and diversity, rather than specific conformity, should be the outcome of the present instability described by Prof. Burr.

In order to compress into six years both a cultural and a technical education, especially where combined with actual experience as at Antioch, it is necessary completely to recast our ideas of a cultural education. At Antioch we take it to mean a general knowledge and view of the entire field of human interest and experience. With that aim in view there is provided a general course in which there are few if any electives except those earned by proven capacity.

There is a profound difference between a general view and a smattering. Take the subject of history, for instance. H. G. Wells in "An Outline of History" has given a general view of the whole period of human history; a mastery of which I believe is of far more cultural value than a similar time spent in some restricted historical period, as is the habit in many liberal colleges. Well's "Outline" is mentioned as a type, and not for its individual excellence. The fields of physical science, biology, and literature can be treated similarly, and the ground decently covered in the allotted time. In engineering subjects it will be necessary to spend the time largely on fundamentals, leaving specific applications to be secured during working periods or through seminars, or if necessary by advanced training in purely professional schools, as suggested by Prof. Burr. With the improvements in secondary education outlined by Prof. Burr, a student of "A-grade intelligence" could complete this entire program, including two years of specialized post-graduate study, by the time he is twenty-four.

Yellow Springs, Ohio, Sept. 20, 1921. ARTHUR E. MORGAN, President, Antioch College.

Sir—Prof. Burr's paper is timely and has opened for discussion a subject that has been given considerable attention by teachers and practicing engineers.

One point commonly overlooked is that the aim of our engineering schools and colleges (the name signifies little) in the undergraduate courses is largely to fit men for the business and industrial world. Those students who intend to follow engineering as a profession must either take graduate work or serve an apprenticeship under professional advice. Thus, engineering institutions are really trying to fit men for two types of life work, namely, that of the graduate who undertakes construction, drafting, sales, etc,. and that of the truly professional man who goes into design or consulting work. One course can not be made to meet both conditions. Our present system serves its purpose well with the exception that the courses are often too highly specialized. Unfortunately, as Prof. Burr points out, the student who intends to enter the profession of engineering is handicapped by lack of instruction necessary to place him on a par with men of the other profession. His endeavors must be confined to graduate study which in many instances consists in doing senior work in greater detail. In addition to the present curricula, there should be scheduled six-year courses for those who intend to enter the profession. Only institutions well equipped to undertake graduate work should attempt to install the long courses and some distinction in the degree granted must be made. The number of applicants will be admitted not because of financial inability nor lack of intelligence but because most of our students do not intend to enter the profession. Furthermore, the opportunities of the professional engineer are more limited in the amount of work to be done than are those of the lawyer or the physician.

The practice of lawyers and physicians is consulting work and when comparison is made with engineers such comparison should be limited to consulting engineers who represent the truly technical men. The standing of consulting engineers in a community is as high on the average as that of the members of any of the other professions.

F. W. GREVE,
Assoc. Prof. of Hydraulic Engineering Purdue University.
Lafayette, Ind., July 29, 1921.

Credit for Sounding Rod Rig

Sir—In order to correct any impression that the writer or his company was the originator of the sounding rod detail described by the writer in *Engineering News-Record*, Sept. 29, p. 539, may I ask you to print that we first heard of the scheme from the Raymond Concrete Pile Co.

New York City, Oct. 1. GEORGE E. HORR.

Problems in the Chlorination of Water

Sir—In the article on "Problems in the Chlorination of Water," *Engineering News-Record*, Sept. 8, p. 393, you have misquoted us or at least there has been an error in presenting what we intended to say. The answer to Question 2 read, "The public does not become accustomed to tastes and odors in chlorinated water," but it should have read: "The public does become accustomed." If you read the following sentence in the same paragraph you will see that this is what the writers intended in answering this question.

Baltimore, Sept. 10. A. E. WALDEN, S. T. POWELL.

Henry Ford's Operation of the D., T. & I.

Sir—Your editorial in the issue of Sept. 1 on "Discounting Efficiency" is timely in calling attention to the fact that there has been an increase in operating efficiency on the Detroit, Toledo & Ironton Railroad, as well as in its traffic and financial standing.

But was due thought given to the efficiency which any organizer can put into a plant, railroad or industrial, by furnishing new capital for the necessary improvements which will permit greater economy of operation? Installation of modern equipment, strengthening of roadbed and bridges, mechanical devices for saving labor in stations and shops, cost money, and bankrupt, or semi-bankrupt, roads have knowingly to get along with obsolete material, at large expense for labor and maintenance.

Was allowance also made for the fact that a certain amount of new capital was put into the property by the Federal Administration, as a war measure, the benefit from which was beginning to accrue just at the time Ford took over the property?

There is also a psychological effect on efficiency when the workman realizes that he has good tools to work with.

In the past other railroads have used similar methods to improve their standing. Witness the coal roads, but political cries like "discrimination in rates" and "interlocking directorates" have had their effect in forcing a separation of interests. Is this not really a similar case, not legally, but morally?

New Haven, Conn., Sept. 7. L. J. CARMALT, Consulting Engineer.

Long Howe-Truss Spans on Southern Pacific

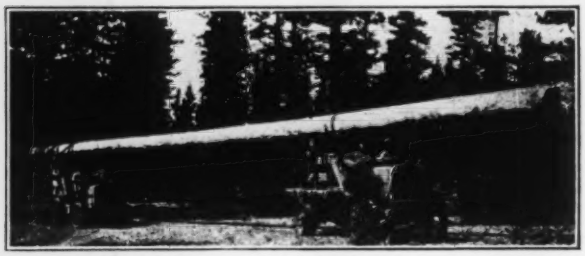
Sir — On page 452 of your issue of Sept. 15 you refer to the recently replaced 174 ft. 10 in. Howe-truss spans across the Allegheny River at Foxburg, Pa., as probably the longest railway Howe-truss spans on record. In their original construction, though long since replaced with steel, there were a number of Howe-truss spans on the Pacific System of the Southern Pacific R. R., that surpassed in length the spans referred to above. Among these were a 176-ft. span across Spring Creek, two 192-ft. spans across Salinas River, two 192-ft. spans across Kings River, one 192-ft. span across Sespe River, all in California, and two 200-ft. spans across Willamette River in Oregon. There is also a description in Johnson's "Modern Framed Structures" (7th Edition, page 356) of a 250-ft. Howe-truss built by this same company on its lines in Oregon.

JOSEPH JACOBS,
Powell & Jacobs, Consulting Civil Engineers.
Seattle, Wash., Sept. 21.

HINTS FOR THE CONTRACTOR

90-Ft. Derrick Mast Hauled on Two Trucks

IN assembling construction equipment on the Pit River hydro-electric project in Northern California, timbers for use in the derricks were cut near the work and hauled in on trucks, as shown in the accompanying illustration. The method of fastening the timbers to the trucks was to build up a heavy timber bolster or cradle on each truck body so the timber would ride well above all parts of the truck, and fasten it there by means of a chain slung around timber and bolster and tightened with a jack. The bolsters were rigidly



MOVING 90-FT. DERRICK MAST IN THE WOODS

attached to the truck bodies, such play as was necessary being allowed by the single wrap of the chain.

Batch Buckets Carried on Flat Cars Used in Building Retaining Wall

IN BUILDING a wall which is to retain a heavy fill between the Grove St. and East Orange, New Jersey, stations of the Delaware, Lackawanna & Western R.R., restricted right of way and inability to reach the work easily except from the railroad grade led to the use of heavy steel batch buckets carried on flat cars for the transportation of concrete from the mixer on one end of the fill to points along the concrete retaining wall.

The heavy steel batch buckets of 2-yd. capacity are placed on flat cars and hauled by a steam dinkey. The dinkey track is interlaid with the broad-gage track over which aggregate is hauled in railroad cars and stock-piled at one end of the fill. Approximately in the middle of the fill (which is about 300 ft. in length) is a stiff-leg derrick which handles the buckets from the flat car to where it is placed in the wall. One and a one-half cubic yards of concrete are carried in each bucket, being two batches from the 3-yd. mixer being used. The mixer platform is built alongside the track so that the mixer can discharge directly into the batch buckets.

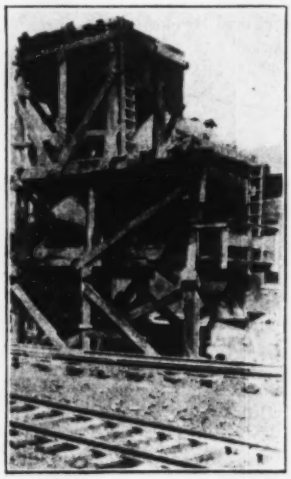


FIG. 1. CONCRETING PLANT

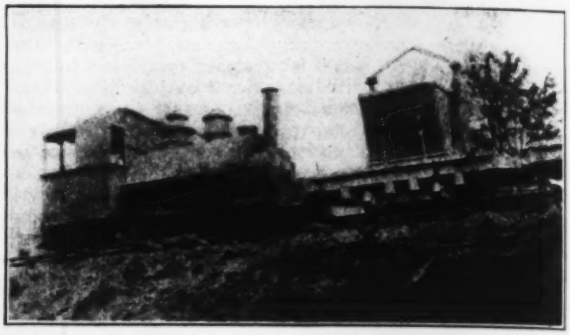


FIG. 2. DINKEY TRAIN TRANSPORTING CONCRETE

This particular wall which forms part of the grade elimination work being done by the D. L. & W. and known as the East Orange Improvement, is being built by F. M. Talbot & Co., railroad contractors.

Store Excavated Sand on Building Site

Sand and gravel excavated for the site of the Palace Theater at South Bend, Ind., was stored in a large pile at the center of the site for use in the concrete of the foundation and the mortar for the brickwork. This saved the expense of hauling the material away to a storage yard and bringing it back again as required. The lot is 108 x 165 ft., to be entirely covered by the building and having no storage space on either side. The material is an excellent grade of torpedo sand.

As the auditorium occupying the center of the site will be spanned by steel trusses there were no interior columns to be interfered with by the stock pile. Excavation of the foundation trenches and basement was done by teams and drag scrapers, the material being dumped to form a tall conical pile. The vertical face of the excavation was sheeted and the forms were braced against it, so that the pouring of concrete was being done at one point while excavation was proceeding at another point. Practically all of this sand will be used before the structure is ready for the trusses, so that there will be a clear and level space for the steel erection. The Ralph Sollitt & Sons Construction Co., Chicago, had the contract for this building.

Wood Column Tests to Be Conducted at Madison

For the purpose of obtaining data on the effect of density and defects such as knots, checks and cross grain on the strength of structural columns of Southern pine and Douglas fir, a series of column tests covering a period of four years will soon be started at the Forest Products Laboratory at Madison, Wis. The tests will be carried out under the direction of J. A. Newlin, in charge of timber tests at the laboratory and Dr. D. F. Holtman, construction engineer, National Lumber Manufacturers' Association. The latter will furnish the material, which it is estimated will consist of 160 pieces of 12 x 12-in. x 24-ft. timbers.

NEWS OF THE WEEK

New York, October 6, 1921

N. Y. Transit Commission For City-Owned Lines

Private Operation Recommended in New Body's First Report—Unified System Urged

Valuation, consolidation and municipal ownership of all transportation facilities in New York City are favored in a report made public Sept. 29 by the N. Y. Transit Commission. The plan proposes the consolidation and municipal ownership of all surface, sub-surface and elevated lines, deemed by the commission to be useful and essential, and their inclusion in three new operating groups. Group 1 comprises the subway and elevated railroads now operated by the Interborough Rapid Transit Co., and leased by it from the city, and the Manhattan Railway Co. Group 2 includes the subway, elevated and surface railroads now or formerly operated in the Brooklyn rapid transit system; and Group 3 embraces the surface railroads of the boroughs of Manhattan and the Bronx.

The plan also proposes administration of all lines by a board of control of seven members. Operation is to be carried on by three operating corporate agencies to be created for the purpose. It is the commission's plan that the transportation lines be acquired without delay by the city, by amortizing out of earnings the valuation fixed by the Transit Commission. Existing securities would be replaced by an issue of bonds of a consolidated company representing a new physical valuation of the properties.

The rates of fare are to be based on actual cost and automatically determined by the amount of a contingent reserve or barometer fund. It is the Transit Commission's hope that the 5-cent fare may be retained, and that the charge for transfers can be abolished. New construction is provided for in the proposal by increasing the city's debt-incurring capacity. Participation by operating personnel as well as new security holders in surplus profits resulting from efficient management and operation is also a proposal in the readjustment plan.

The members of the Transit Commission making the report are George McAneny, John F. O'Ryan, and LeRoy T. Harkness.

Traffic Doubles in 30 Months

Traffic over the highways of California is doubling every 30 months according to a report recently issued by the California Highway Commission and based on records from the 3,200 miles of highway which the commission has constructed and is maintaining.

Engineers Urge Public Works Boom to Aid Unemployed

At their seventeenth annual convenvention held in Tacoma, Sept. 12-14, county engineers of the State of Washington adopted resolutions urging county boards, city commissioners, and state officials to proceed with all justified public improvements, as a means of reducing unemployment. A policy also was endorsed of having the various counties co-operate with the state in the purchase and use of devices for weighing loaded motor trucks on the main highways, to prevent overloading.

The association elected the following officers: E. A. White, president; J. L. Thayer, vice-president; Thomas Meads, secretary-treasurer. Next year's convention will be held at Walla Walla.

May Defer Shadesville Bridge

No action has yet been taken by the county commissioners of Franklin County, Ohio, to readvertise the construction of the Scioto River bridge at Shadesville. The first contract, awarded on a bid approximating $400,000, was stopped by an injunction on application of the county prosecutor because of illegalities in the letting. While the Chamber of Commerce of Columbus has adopted resolutions asking that the construction of the bridge proceed, some of the commissioners are disposed to wait for further reduction in the cost of labor and materials, believing that a saving of $100,000 can be made if the project is held up a year or so.

Federation Will Organize Paid Employment Service

Decision Reached by Executive Board Last Week—Dean Cooley New President

Approval was given by the executive board of the Federated American Engineering Societies at its meeting in Washington Sept. 30 to the plan of organizing a paid employment service for engineers. Dean Mortimer L. Cooley, of the colleges of engineering and architecture, University of Michigan, was elected president of the American Engineering Council to fill the vacancy created by the resignation of Herbert C. Hoover, made necessary by his appointment by President Harding as Secretary of Commerce. It is understood that Prof. Cooley has made arrangements which will enable him to give one-fourth of his time to active work for the organization.

The board adopted recommendations covering improvements in government contracts, endorsed the principle of a paid employment service for engineers referred to the committee on printing the proposal to publish a journal, authorized the secretary to form administrative committees in the states, abandoned the project for an engineering assembly in Washington at the time of the council's annual meeting in January, and recommitted the report of the committee on licensing of engineers.

Included in the approved recommendations of the committee on gov-

Unemployment Conference Reports Emergency Measures

THE President's unemployment conference completed on Sept. 30 the first part of its work—the consideration of measures for emergency relief of unemployment—and then adjourned to meet again Oct. 10 in order to consider measures for preventing or mitigating unemployment periods in the future.

Organization of the conference was effected Sept. 26 and the work divided among committees on statistics, employment agencies, emergency measures in public works, in manufacturing, in transportation, in construction, in mining, and in shipping. These committees immediately got to work and though it was not expected that they would be ready to report until Oct. 5, such progress was made that they presented their findings to the conference as a whole Sept. 30 and adopted recommendations with reference to emergency measures. These will be found elsewhere in this issue, while the editorial pages carry comment on the conference and its results.

The following men intimately connected with the construction industry were members of the conference:

Winslow B. Ayer, president Eastern & Western Lumber Co., Portland, Ore.; C. M. Babcock, highway commissioner of Minnesota, St. Paul; John Donlin, president of the building trades department, American Federation of Labor; John H. Kirby, president Kirby Lumber Co., Houston, Tex.; Brig.-Gen. R. C. Marshall, Jr., general manager Associated General Contractors: Ernest T. Trigg, vice-president John Lucas & Co., and president of the Federation of Construction Industries; Sanford E. Thompson, consulting engineer, Boston.

ernment contracts (A, P. Davis, chairman; Col. C. O. Sherrill, D. K. Boyd, Charles F. Ruffner, W. M. McFarland and Peter Junkersfeld) were the following:

1. Favoring unit-price, lump-sum or purchase-and-hire basis in preference to cost-plus.

2. Advocating appointment by the President of an inter-departmental board on standardization of contracts.

3. Urging promptness in making partial payments for work done.

4. Opposing boards of arbitration and giving contractor right of appeal up to bureau chief.

5. Endorsing principles of justice in making deductions for non-completion of work on time.

EMPLOYMENT SERVICE

More attention was given the report of the special commission on employment service, of which Morris L. Cooke is chairman, than to any other subject taken up by the board. From the discussion, a resolution grew which points out the pressing need for a unified employment service for engineers "national in scope, local in application and financed for adequate service." Since the constituent societies are not able to provide a free service, the executive board endorsed the principle of a paid employment service, but with reduced fees for members of the organizations that support it. The chairman of the executive board is to appoint a committee of five members, while each of the boards of the four founder societies is to designate one of its members so as to provide a committee of nine members on engineering employment. This joint committee is to organize the employment bureau.

The committee on finance was given broad powers to deal with financial arrangements with member societies. At the time the federation was formed the numerical strength of most engineering societies was at its peak. With the industrial depression, there have been losses of members and several suggestions to relieve the situation have been offered. Edwin Ludlow suggested that the American Institute of Mining and Metallurgical Engineers would like to revise the agreement so that payment of the contribution to the federated societies could be made on a basis of paying members. After some discussion, it was decided to adopt no rigid policy in the matter, but to give the finance committee authority to deal with the matter as it sees fit.

ENGINEERING ASSEMBLY ABANDONED

Authority was given to Secretary Wallace to form administrative committees in the several states.

The Engineering Assembly, which was being considered in connection with the annual meeting of the council in January, was abandoned. The feeling was that the business depression would militate against the success of a general meeting of engineers at that time.

After listening to the report of the committee on licensing the board agreed that further work must be done in perfecting the uniform licensing bill. The whole matter was recommitted to the committee.

Those in attendance at the executive board meeting were: G. S. Williams, Ann Arbor, Mich.; Lloyd B. Smith, Topeka; Arthur M. Greene, Jr., Troy, N. Y.; Wm. McClellan, Philadelphia; S. H. McCrory, Washington, D. C.; H. E. Howe, Washington, D. C.; Morris L. Cooke, Philadelphia; W. B. Powell, Buffalo; C. F. Scott, Yale University; W. W. Varney, Baltimore; L. P. Alford, New York City; P. N. Moore, St. Louis; W. E. Rolfe, St. Louis; Calvert Townley, New York City; Fred J. Miller, Stockton, N. Y.; Edwin Ludlow, New York City; Arthur S. Dwight, New York City; J. P. Channing, New York City; O. H. Koch, Dallas, Texas; D. S. Kimball, Ithaca, N. Y.

Many Changes Made in Newark's Engineering Personnel

As a result of a reorganization of the Department of Streets and Public Improvements of Newark, N. J., effective this month, many changes in engineering personnel have been made. Morris R. Sherrerd has been replaced, as chief engineer, by John A. Foulks, formerly an assistant chief examiner of the Civil Service Commission, who will have charge of the city's new water supply division. Mr. Sherrerd, it is understood, will be called upon for consulting advice. In the reorganized service James W. Costello heads the division of works and Harrison R. Van Duyne will be chief of the division of surveys and accounting.

Providence Awards Contract for Feeding Garbage to Hogs

A five-year contract for garbage collection and disposal by feeding to hogs, was awarded Sept. 30 by Providence, R. I., to Joseph J. Nugent. The average yearly contract price is $80,000, beginning at $100,000 for the first year and diminishing by $10,000 a year. The contractor will provide a loading station in Providence and will maintain a sufficient number of hogs to consume the garbage, which it is supposed will be about 6,000.

Although bidders were permitted to adopt either hog feeding, reduction or incineration as a means of disposal, the only formal bid received was for disposal by feeding. The highest bidder ($120,000 a year) offered to get rid of the garbage without a loading station in the city. A bidder at $107,000 conditioned his bid on the city providing a loading station, wagons and buildings for his horses and men; or as an alternative he proposed to do the work for $3,590 per year per team. All three of the bids mentioned were for five years. The fourth bidder offered to do the work for $90,000 a year on either a six-months, one-year or three-year contract. Dr. Charles V. Chapin is superintendent of health in Providence.

Steel Bridge Wrecked by Auto Collision

Truss Members Knocked out by 5-Ton Truck and Structure of 100-ft. Span Falls

A steel truss highway bridge of 100 ft. span, at Savage, Md., was completely wrecked Sept. 21 as the result of the grazing collision of two motor cars on the bridge. John N. Mackall, chairman and chief engineer of the State Roads Commission, gives details of the accident as follows:

"Over the Little Patuxent River on the Baltimore-Washington boulevard at Savage, there was a pin-connected, through-truss bridge of a span of 101 ft., with a clear roadway of 14 ft. The bridge was marked with signs of standard size placed 300 ft. from the ends, notifying the public that it was a one-way structure. A 5-ton truck loaded with asphalt approached the bridge from the north at the same time a light passenger car approached from the other side. Instead of one or both stopping, they rushed on the bridge and met at about the center. The truck and car side-swiped, doing little damage to the truck, but tearing the front and rear fenders and running board off the automobile. The impact caused both the truck and car to turn around on the bridge, and the truck knocked out several of the vertical and diagonal members, both compression and tension, as the result of which the entire bridge collapsed. The truck went down with the bridge.

"There are on the state road system in Maryland about 20 one-way bridges which are being replaced as rapidly as as funds are available. The inevitable result is failure of the structure whenever an accident of this kind occurs. The bridge was regularly inspected and was amply strong in every respect to carry any load which was likely to come on it. When the First Division was going to Washington for the Pershing parade in 1919, one of the army trucks knocked down a bridge at Conowingo over the Conowingo Creek in a similar manner. No injury was done to anyone at this time.

"A contract has been awarded for the rebuilding of this bridge, work has begun and we expect to have it completed within 30 days. A reinforced-concrete arch of a clear width of 24 ft. between curbs will replace the demolished steel structure."

Health Exposition to Be Held in New York City

A health exposition of "approved articles of health value" by commercial houses and educational and philanthropic organizations will be held in the Grand Central Palace, New York City, November 14-19—the week of the fiftieth annual convention of the American Public Health Association.

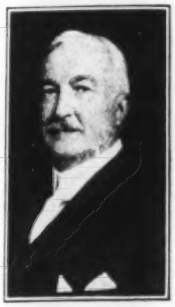
Further information may be obtained from the association at 370 Fifth Ave. New York City.

Three Triple-Expansion Pumping Engines for Milwaukee

Bids for one 25 and two 22-m.g.d. vertical triple-expansion pumping engines, erected in the Riverside pumping station, are wanted by Percy Braman, commissioner of public works, Milwaukee, Wis., up to 10:30 a.m., Oct. 24.

Dean Cooley New President of Federated Societies

Dean Mortimer L. Cooley, of the University of Michigan, whose election to the presidency of the Federated American Engineering Societies is announced in another column, has, in addition to his collegiate duties, taken an active part in the field of railway valuation and the appraisal of public utilities and private industrial properties, having served also as chief engineer in charge of appraisals of water and steam power development and electrical distribution for the Michigan State Railway Commission. Dean Cooley is a past-president of the American Society of Mechanical Engineers, served for five years as chairman of the block signal and train control board of the Interstate Commerce Commission, and has been for sixteen years dean of the school of engineering and architecture at the University of Michigan.



He was born in Canandaigua, N. Y., in 1855, and was graduated from the U. S. Naval Academy in 1874. After several years of sea duty he was assigned, as cadet engineer, to the bureau of steam engineering of the Navy Department. In 1881, as assistant engineer, he was ordered to the University of Michigan to teach steam engineering and shipbuilding. Four years later, at the request of the regents, he resigned from the Navy to accept the chair of mechanical engineering at Michigan. Largely through his efforts, the engineering department of the university was built up to its present size and in recognition of his service he was appointed dean of engineering in 1904, having served continuously since that time.

Among Dean Cooley's professional engagements have been the valuation of mechanical equipment for the Detroit street railways and a physical valuation of railways, telephones, telegraphs, and toll roads of Michigan, involving a total of about $230,000,000. In 1902 he assisted the government of New Foundland in the appraisal of certain railways and served as a member of Chicago's traction valuation committee in 1906. He has been an expert in numerous patent cases and advised on the valuation of the Minneapolis General Electric Co.'s property in 1897.

Bids for Large Pumps Wanted by Montreal Water Board

Bids for one, two or three 30,000,000-gal. electric driven centrifugal pumps for the water-works of Montreal, Que., are to be received by the local water board until Oct. 10.

Break in Tunnel Deadlock Seems Near

New York Commission Forces Jersey Body to Declare Itself on Railway Siding Controversy

While it cannot yet be said that the deadlock between the New York and the New Jersey tunnel commissions, which for months has prevented a start on the construction of the Hudson River vehicular tubes, has been broken, events at last week's meeting of the two bodies indicate that the New Jersey commission members are facing the necessity of laying their cards upon the table as the result of the New York demand, made by Gen. George R. Dyer, chairman, for a showdown by the Jersey members on their position of insistence upon perpetual rights for a railroad siding serving the warehouse of the Union Terminal Cold Storage Co., of which T. Albeus Adams, chairman of the New Jersey commission, is president. The New York commission, he said, would never approve a contract with such a clause.

The issue was brought to a head by E. W. Bloomingdale's specific inquiry as to whether or not the New Jersey commission would accept the contract if the Erie R.R. agreed to the omission of any reference to the siding. The New York members submitted the following statement which will be considered by the New Jersey body.

NEW YORK'S PROPOSITION

"It is agreed that if the Erie R.R. will accept contract tendered by the New York commission under date of Sept. 15, which contract contains no reference to the railroad siding, the New Jersey commission will ratify and agree to said contract on its part. It is further agreed that if the Erie R.R. insists upon the inclusion in the contract of the provision contained in the form tendered by the New Jersey commission, which provides for the maintenance of the railroad siding, the New York commission will agree to, ratify, and confirm said contract, provided said inclusion is so framed that the rights of all parties thereto shall remain as they are of this date. It is further agreed between the two commissions that no ordinance or resolution in any form providing for the maintenance of said railroad siding shall be adopted by the authorities of the city of Jersey City, nor will the authorities take any other action that will give rights to claim damages to any of the parties concerned with or having an interest in said railroad siding and that the New Jersey commission will obtain from the Jersey City authorities the necessary assurances to that effect."

Road Transport Progress Shown in Pageant

A Conestoga wagon built in 1802, a one-cylinder Cadillac car built in 1902, the famous Washington coach from Valley Forge, a Concord stage coach, a "one-hoss shay" built in the eighteenth century, and dozens of other ancient and modern vehicles were features of the pageant depicting the development of road transportation, which was held at Caledonia Park, between Gettysburg and Chambersburg, Pa., Oct. 4. The Pennsylvania Highway Department and the local automobile clubs were in charge of the program.

The pageant comprised 30 episodes, starting with a lone Indian on his pony and ending with a $15,000 passenger automobile.

Railway Bridge and Building Men to Meet in New York

At the annual meeting of the American Railway Bridge and Building Association, to be held at the McAlpin Hotel, New York City, Oct. 18-20, the subjects of reports to be discussed will include cleaning structural steel before painting, lining tunnels under traffic, construction of station platforms and engine ashpits, tool equipment for pile driver outfits, and the detection and repair of leaks in water mains.

Paving Policy for D. C. Suburban Roads Announced

All suburban roadways in the District of Columbia in the future will, where possible, be built of concrete with the idea of resurfacing them with sheet asphalt, as that may become necessary. This policy was revealed in the annual report to the District Commissioners by C. B. Hunt, engineer of highways. The policy is based on experience with streets which have been resurfaced in that manner.

Indian Engineer Completes Study of American Roads

K. G. Mitchell, of Lahore, Punjab, India, who is connected with the Indian Board of Communications, sailed last Saturday for England after having spent six weeks in the United States studying concrete and dirt road practice and American machinery.

Most of the roads in the Punjab are of dirt, though there are about 1,300 miles of water-bound macadam. The chief traffic consists of steel-tired carts, drawn by bullocks, which have tire widths of about 2½ in., and impose heavy concentrations upon the road, loads of 2½ tons on two wheels not being uncommon. As a result the earth roads are badly rutted and macadam crusts are quickly broken through. In consequence the authorities are considering the construction of a considerable mileage of concrete road.

Standards Specified for Steel and Explosives

Three specifications have been submitted to the American Engineering Standards Committee for approval. Two of them, defining automatic screw steel of bessemer and open-hearth process, are submitted by the American Society for Testing Materials; a specification for the testing and use of mine explosives is submitted by the U. S. Bureau of Mines. All were originally formulated on the basis of extensive tests and have been in use for several years. The two steel specifications, formulated in 1914 and 1915 respectively, are proposed as American standards, while the explosives specification, which in its finally revised form was issued last April, is proposed as tentative American standard.

I. C. C. Has Tentative Plan to Merge Railroads in 19 Systems

A tentative plan for the consolidation of all the major railroads of the country into nineteen big systems, a recommendation provided for in the Transportation Act, was announced September 28 by the Interstate Commerce Commission. The proposed combination is designed to remove weaknesses in the national railroad systems and to effect economic readjustment of terminal and other subsidiary facilities. The plan follows the consolidation plan worked out by Professor William Z. Ripley, of Harvard, though some changes have been made.

The groupings, as shown below, contain only the principal roads in the various proposed systems.

Group 1—New York Central; Michigan Central; Boston & Maine; Cleveland, Cincinnati, Chicago & St. Louis.

Group 2—Pennsylvania; Pittsburgh, Chicago, Cincinnati & St. Louis.

Group 3—Baltimore & Ohio; Reading system; New York, New Haven & Hartford.

Group 4—Erie; Delaware, Lackawanna & Western; Wabash lines east of the Missouri.

Group 5—Lehigh Valley; New York, Chicago & St. Louis.

Group 6—Pere Marquette; Detroit, Toledo & Ironton.

Group 7—New York, New Haven & Hartford; Boston & Maine.

Group 7a—Commission here proposes Group 7 consolidated with Delaware & Hudson, Ulster & Delaware; Delaware, Lackawanna & Western; Buffalo, Rochester & Pittsburgh; Pittsburgh & Shawmut; Pittsburgh, Shawmut & Northern, as a variation.

Group 8—Chesapeake & Ohio.

Group 9—Norfolk & Western; Toledo & Ohio Central.

Group 10—Southern; New Orleans Great Northern.

Group 11—Atlantic Coast Line; Carolina, Clinchfield & Ohio; Florida East Coast.

Group 12—Illinois Central; Seaboard Air Line; Carolina, Clinchfield & Ohio.

Group 13—Union Pacific; Chicago & Northwestern; Wabash lines west of the Mississippi.

Group 14—Chicago, Burlington & Quincy; Northern Pacific; Chicago Great Western.

Group 15—Chicago, Milwaukee & St. Paul; Great Northern; Spokane, Portland & Seattle.

Group 16—Atchison, Topeka & Santa Fe; Denver & Rio Grande, Western Pacific.

Group 17—Southern Pacific; Chicago, Rock Island & Pacific.

Group 18—St. Louis-San Francisco; Chicago & Alton; Missouri, Kansas & Texas.

Group 19—Chicago & Eastern Illinois, Missouri Pacific, Kansas City Southern.

Engineers Take Active Part in Drainage Congress

A new constitution embodying the principle that private drainage projects should not seek federal aid was adopted by the National Drainage Congress Sept. 22-23, at its meeting in St. Paul, noted in last week's issue of this journal, p. 541. Flood control in its close relation to land drainage was discussed and there was an opinion that in some drainage projects the flood effect on downstream conditions has not been given due consideration. In a paper on "Flood Control Legislation," Frank L. Cliff, Ortonville, Minn., took the position that while the boundaries of drainage districts include only property subject to assessment, a flood control project should include the entire area of a basin whose runoff passes through one outlet. This led to discussion as to whether uplands should be assessed for drainage.

Outlet drainage districts to provide joint outlets for groups of districts were discussed by L. K. Sherman, consulting engineer, Chicago. Such projects are often opposed on the ground that the straightening and deepening of a channel will result in higher flood levels at the lower end. Mr. Sherman explained that as the improved channel gives greater velocity it will carry off more water during the earlier stages of a storm, thus reducing the amount which passes at the crest of a flood.

State control of drainage projects as a check upon speculation and development was urged by S. H. McCrory, chief of drainage investigations, U. S. Department of Agriculture.

A monthly magazine and a paid secretary were decided upon in a policy of expanding the work of the National Drainage Congress. The president is Clark E. Jacoby, consulting engineer, Kansas City, Mo., with vice-presidents as follows: Jacob A. Harman, consulting engineer, Peoria, Ill.; F. H. Newell, consulting engineer, Washington, D. C., and A. J. Bracken, Chicago. The secretary and editor is Robert A. Glenn. It was voted to hold the 1922 meeting at Kansas City, Mo.

Am. Soc. C. E. Canvasses Ballot on Amended Constitution

The ballot on the proposed amendments to the Constitution of the American Society of Civil Engineers, canvassed at the regular business meeting held last night in the Engineering Societies' Building, New York City, resulted as follows:

FOR Adoption 1,367

AGAINST Adoption 326

Note: An affirmative vote of two-thirds of all ballots cast is necessary to the adoption of any amendment to the constitution.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; Annual Meeting, New York City, Oct. 18-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; Annual Convention, Baltimore, Md., Oct. 24-28.

CITY MANAGERS ASSOCIATION, Spartanburg, S. C.; Annual Meeting, Chicago, Nov. 14-16.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

The Municipal Engineers of the City of New York held its monthly meeting on Sept. 28. Thomas H. Wiggin addressed the society on the subject, "An Engineer's Two Years in China." Mr. Wiggin has recently returned from China where he spent two years in charge of engineering investigations for the improvement of the Grand Canal of China and the control of the floods of the Yellow River.

The Seattle (Wash.) Engineers' Club was addressed, Sept. 17, by C. E. Drayer, secretary of the American Association of Engineers, on "Engineering Service."

The Harvard Engineering Society, at at a joint meeting with the Harvard Club of New York, Oct. 14, in New York City, will be addressed by Clifford M. Holland, chief engineer, New York and New Jersey tunnel commissions on "The Vehicular Tunnel," and by George A. Post, president Hudson River Bridge Corp., on "The Proposed Suspension Bridge."

Personal Notes

JOHN E. JOHNSON, civil engineer of Paducah, Ky., has been appointed highway engineer for the western district of the State Highway Department of Kentucky, succeeding HUGH CROZIER, who has been appointed assistant engineer in the headquarters office at Frankfort.

MAJOR U. S. GRANT, 3rd, Corps of Engineers, U. S. Army, has been appointed a member of the California Debris Commission.

CAPTAIN JOHN K. ROBINSON has been promoted to be chief of the Bureau of Engineering, U. S. Navy.

THOMAS N. GILMORE has opened an office as consulting engineer in New York City to specialize in layouts and designs of railroad shops, locomotive terminals, power plants, steam stations and industrial plants and in the improvement of these facilities. For the past 16 years he has been connected with Westinghouse, Church,

Kerr & Co. in charge of railroad shop design and construction and later as vice-president and chief engineer in charge of all engineering and construction.

J. B. MAYES, formerly connected with the South Carolina State Highway Department, has been appointed road engineer for Williamsburg County, S. C.

WILLIAM C. H. LEWIS and LAWRENCE WILEY have organized the firm of Lewis & Wiley, Ltd., sluicing contractors, with headquarters at Alix, Alberta, where the firm has entered into a contract for sluicing off a 30-ft. overburden from the seam of coal in the mine of the Tredway Coal Co., the work involving the handling of about 2,000,000 yd. of earth. The two principals are sons of the men who organized the Lewis-Wiley Hydraulic Co., and carried out extensive sluicing contracts in Seattle, Portland and other parts of the northwest some years ago.

H. M. SMITTEN, formerly lieutenant-colonel, 37th Engineers, A. E. F., and, since his discharge from the service, engineer in the valuation department of the Southern Pacific R.R. Co., has resigned to become bridge engineer for the Western Pacific R.R.

PHILIP K. SCHUYLER, formerly in the bridge department of the Wisconsin Highway Commission, has taken a position with the bridge department of the North Carolina Highway Commission, of the North Carolina Highway Commission, at Raleigh, N. C.

VIRGIL KLINE, formerly engaged in road building in Lowndes County, Ga., has been appointed resident engineer for the Georgia State Highway Department in charge of road building in Brooks County.

PROF. HALE HOUSTON who has been in charge of the civil engineering department of the Clemson Agricultural College, Clemson College, S. C., has resigned to become connected with Washington and Lee University.

E. L. CLARKE, for a number of years connected with the Westinghouse, Church, Kerr & Co., has been appointed professor in charge of the civil engineering department of Clemson (S. C.) Agricultural College.

FRANK JOYNER, for many years road commissioner of Los Angeles County, Cal., and recently consulting engineer for the Western Willite Road Construction Co., Los Angeles, has resigned to engage in general consulting and highway engineering practice.

CHARLES A. MAY, for some time asistant state highway engineer of New Mexico, has been appointed state engineer.

ALBERT GIVAN has been appointed city engineer of Sacramento, Cal.

CHARLES R. VANNEMAN, formerly inspector of transportation and recently in charge of most of the engineering work of the old Public Service Commission for the Second District, N. Y., has been appointed chief engineer of the New York State Public Service Commission and will have charge of the engineering and inspection work for all steam railroads, street railways, grade crossings, electric light companies, and telephone and telegraph companies.

LEO K. KENNEDY has been appointed civil engineer for the Happy Valley Irrigation District, Cal., and will direct the completion of the Hoover tunnel and other improvements.

ADMIRAL ROBERT GRIFFIN, for more than 8 years head of the bureau of engineering of the Navy Department and engineer in chief of the Navy, terminated 40 years of active service on Sept. 22 and retired to private life. His influence was responsible in large measure for the adoption of the electric drive for battleships and, under his direction, high-powered radio stations were built at Panama, San Diego, Pearl Harbor, Cavite, Annapolis and Bordeaux, France. The latter was erected during the war, and ranked as the world's most powerful station.

J. A. BERNIER has been appointed city engineer of Shawinigan Falls, Que.

THOMAS H. MACDONALD, director of the U. S. Bureau of Public Roads, recently made an extended automobile trip over some of the newer highways in New York and New England. He was accompanied by A. R. Hirst, state highway engineer of Wisconsin.

OBITUARY

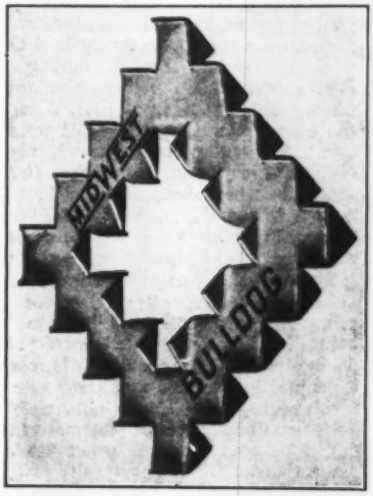
CHARLES L. HYDE, president of the C. L. Hyde Construction Co., San Diego, Cal., died Sept. 17 in San Diego. He was born in Salt Lake City, Utah, in 1862. In 1910, with Jesse Knight, he formed the Knight & Hyde Construction Co. He built many of the roads at Loma Portal, Sunset Cliffs and Point Loma and aided in the grading of Redondo Beach and San Pedro and built a section of state highway in Riverside County, Cal.

S. S. VOORHEES, one of the principal technologists of the U. S. Bureau of Standards, died Sept. 24 in Portland, Me., as the result of an operation. He was born in Springfield, Ohio, 1867, and was educated at Lehigh University and George Washington University. From 1887 to 1896 he was assistant chemist, Cambria Iron Co. and Pennsylvania R.R., Altoona, Pa. He also served as chemist in charge for the Southern Ry., Washington, and for the New York Central & Hudson River R.R. From 1901 to 1908 he served as engineer of tests, U. S. Supervising Architect's Office and later, for 2 years, with the U. S. Geolgical Survey. He has been an engineering chemist in the U. S. Bureau of Standards since 1910. Mr. Voorhees was prominent in the American Society for Testing Materials, of which he was vice-president from 1916 to 1918.

EQUIPMENT AND MATERIALS

Timber Joint Plate

The Midwest Steel & Supply Company, Inc., New York City, has devised a simple system of connecting wooden beams and stringers. It is manufacturing the "Midwest Bull Dog" which is a steel plate provided with a number of sharp strong teeth on both sides. When placed between two wooden members and the joint is drawn up tight with the bolt going through the square hole in the plate, great rigidity and



strength are provided. As the nut is tightened the teeth cut into the wood evenly and easily on both sides and a firm connection is made. It is made of a special quality of cold rolled steel, having a high tensile strength combined with great ductility. The normal size is approximately 4 in. square. It is suitable for use in connection with standard bolts from ½ in. to 1½ in. in diameter and is usually packed in crates of 100 each, weighing approximately 25 lb.

Out of the Ordinary Trade Publications

The advantages of the conical mill method of pulverizing fuels are set forth in a catalog issued by the HARDINGE CO., New York City. The Hardinge mill operates on the principle of a multiplicity of grinding bodies rolling in a rotating conical drum supported on hollow trunions, through which the material passes into and out of the grinding zone. The grinding bodies in rolling and dropping grind and crush the material passing through the mill. For those demanding a very high combustion efficiency in fuel used, this bulletin from the Hardinge Conical Mill, complete as to the description of the method of installation of a conical mill and as to the various processes used in grinding fuel, will be interesting. The catalog is well illustrated.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Common Brick Shows Decided Production Impetus

Quoting from the October *Digest* of the Common Brick Manufacturers Association of America, "The most cheerful aspect of the current month's report is that out of the 126 manufacturers, 69, or more than one-half, report either good or fair outlook for the forthcoming month. This is a decided change from the pessimistic reports of the past." During the month of September, orders for common brick practically held their own, the orders booked during the month equaling in volume the orders filled. Shipments from plants during the month have about equaled production. The 126 manufacturers, representing every section of the United States in which common brick is made in any quantity, show 254,000,000 burned brick on hand with orders on their books for 158,000,000.

The composite price of burned brick as reported from all sections of the country, shows another slight recession, being $13.87 as compared with $14.04 on September 1. This figure is merely a composite one and not a representative figure. The *Digest's* indicates that the prevailing price of common brick might be said to be between $15 and $16 a thousand. The composite price is brought to an abnormally low level by the competitive prices.

Labor and fuel conditions in the industry continue to be satisfactory. About 35 plants among the firms reporting are still shut down on account of no demand. These are largely in the western and northern states, as usual, the pick up showing itself first in the East and then moving westward.

July Marked Turning Point in Steel Production

Continued improvement in the steel industry is indicated in reports received by Walter F. Tower, chief of the iron and steel division, U. S. Department of Commerce. Writing in a recent issue of *Commerce Reports* Mr. Tower asserts that "as expected the August figures for production of pig iron and steel ingots showed an upward trend from the low point touched in July, and further increases in operation during September strengthen the conclusion that July actually was the turning point toward better conditions. Steel export activities, however, still lag, for neither volume nor value of shipments during August shared in the increase reported for export.

During August the exports of iron and steel from the United States totalled only 73,792 tons, the lowest point recorded since January, 1909. The total export for the eight months was at the rate of 2,500,000 tons per year.

(1)

Here are a few interesting points regarding September, 1921, contracts:

(2)

Second highest value recorded so far this year—$123,473,797.

(3)

Within one-half of 1 per cent of contract value for September, 1920.

(4)

Taking into account the decrease in the cost of construction during the past year, the value would be, based on 1920 costs, $148,000,000.

(5)

The largest value for miscellaneous building since May, 1920.

(6)

Twice as much water-works and sewer construction put under contract as in September, 1920.

(7)

More industrial work than any month since March, 1921.

(8)

And

(9)

As to contracts let so far this year:

(10)

Street and road work is valued at $258,000,000, as compared to $230,000,000 for the first nine months of 1920.

(11)

The total value of contracts for the first nine months of 1921 is $913,000,000 as compared to $1,314,000,000 for the same period of 1920.

(12)

The average amount of construction work put under contract for the six spring and summer months totaled in value $141,000,000 a month for 1920, and $115,000,000 a month for 1921. Reducing the 1921 figures to a basis of 1920 costs, the 1921 average becomes $143,000,000. In other words, there has been practically the same amount of construction work carried on during this spring and summer as was carried on during the spring and summer of 1920, though the cost this year has been 25 per cent smaller.

May Lower Pittsburgh Bond Issue

Reduction of the proposed $41,000,000 road and bridge bond issue of Allegheny County (Pittsburgh) before it is put to vote of the people Nov. 8 is considered probable. Revision of the estimates for the several improvements to be financed by the bonds in the light of cost reductions made evident by recent bids is the principal element of the expected reduction.

September Second Highest Month in Contracts Let

Total Value Is $123,473,797, Within One-Half of 1 per Cent of the Value for the Same Month of 1920

September proved to be the second best month of 1921 in construction work, judging from the number and value of contracts let as reported to *Engineering News-Record*. The total value of all contracts was $123,473,797. The only month of 1921 so far to exceed September was June, when contracts valued in excess of $140,000,000 were recorded. The value of contracts let in

VALUE OF CONTRACTS LET DURING SEPTEMBER

Classification	1920	1921
Waterworks	$742,791	$1,487,296
Sewers	2,318,687	5,063,900
Bridges	2,750,821	3,405,876
Streets, roads	26,536,814	23,256,996
Excavation	858,751	9,025,229
Industrial	37,709,100	13,259,789
Buildings	45,321,507	60,979,116
Federal government	1,662,264	3,694,113
Miscellaneous	6,259,158	3,301,392
Total	124,159,893	123,473,797

September of this year was within one-half of 1 per cent of the value of contracts let in September, 1920, the latter figure being $124,159,893.

Practically half the money involved in contracts let in September of this year is represented in the construction of miscellaneous buildings such as office and bank buildings, lofts, theaters, schools, churches, etc. The amount of money involved in street and road work is in excess of $23,000,000, and industrial work amounts to more than $13,000,000. This is the second highest figure that has been recorded during 1921 for industrial construction.

The total value of contracts let thus far in 1921 is in excess of $913,000,000, whereas the value for the first nine

VALUE OF CONTRACTS LET DURING FIRST NINE MONTHS OF

Month	1920	1921
January	$175,148,766	$54,328,36
February	148,264,596	56,556,82
March	148,123,161	113,213,84
April	216,568,386	105,667,39
May	165,870,787	108,904,53
June	114,710,161	140,578,81
July	129,284,470	106,011,64
August	92,661,818	104,644,11
September	124,159,893	123,473,797
Total	1,314,792,038	913,378,73

months of 1920 exceeded $1,314,000,000. These figures do not include any housing construction except that for industrial purposes, neither is residential building included.

Inasmuch as there has been a decrease in the cost of construction within the past year of approximately 25

per cent, the amount of money involved in the value of contracts let during September, 1921, would build structures worth more than $148,000,000 if prices existing in September, 1920, were taken into account.

One of the notable points in this past month's value of contracts let is the fact that the total value for miscellaneous building is in excess of $60,000,000, the highest record since May, 1920. Another significant thing is found in the fact that the total value of street and road contracts up to and including the month of September has been more than $258,000,000, as compared to $230,000,000 for the first nine months of 1920. The year 1920 was considered a very good construction year from the standpoint of highway work, yet for the first nine months of 1920 the contract value was but 89 per cent of what has been recorded so far during 1921.

Another notable point is the pick-up in public works construction, the amount of money involved in contracts for the construction of sewers, waterworks, and bridges for September being in excess of $10,000,000. Federal government work has also shown considerable activity. In only three out of the nine classifications of construction work did the year 1920 exceed 1921 to date.

With the large amount of highway work and miscellaneous building work that is contemplated for next year, it is practically certain that numerous contracts will be let during the ensuing fall and winter months.

Engineering News-Record Construction Cost Index Number

October, 1921	182.57
September, 1921	188.27
October, 1920	261.20
Peak, July, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 5.3 (3 per cent) lower than this time last month, owing to decreases in steel and cement. The structural steel base is now $1.75 per 100 lb., as against $1.85 last month. Cement in Chicago is $1.97, as against $2.17 formerly. The average labor rate for the country this month is 50c. Pine in New York remains at $45, to contractors. Thus, general construction cost is 30 per cent cheaper than one year ago and 34 per cent under the peak.

Double Federal Aid to Relieve Employment Is Proposed

The Minnesota State Highway Department proposes to make an appeal to Congress to double the Federal aid highway appropriation for 1921 in order that the work may be continued on a large scale through the winter so as to relieve the unemployment situation.

Labor Rates and Conditions Throughout the Country

Chicago, Montreal, Kansas City and Seattle are the only cities reporting changes in labor rates. The outstanding feature is the recent building wage decision by Judge Landis, in Chicago, which placed brick layers at $1.10 as against $1.25 per hr.; carpenters at $1 as against $1.25; structural iron workers at $1.05 from $1.25, and common labor, union, at 72½c., from $1. Hoisting engineers for operation of high pressure boilers and engines, cable ways, derricks, pile drivers, cranes and cable hoists receive $1.10; others, 85c.

Montreal reports considerable unemployment and slight readjustments in wage rates. Brick layers are receiving 85c. as against 90c. per hr., carpenters 60c.@65c. instead of 65c. per hr., hoisting engineers 50c.@55c. from 60c., hod carriers 35c.@40c., from 40c., structural iron workers 60c., from 65c., common labor 30c.@35c.

In Seattle much of the building construction is being done by non-union labor under the "American plan." Hoisting engineers are receiving 90c., structural iron workers 80c.@90c., and common labor 50c.@60c.

We print the union scale for Kansas City, but non-union labor is plentiful at much lower figures.

In Detroit about 60 per cent of all classes of labor are employed at present, and common labor in many cases is being paid less than the regular rate.

Denver reports that among brick layers, about 60 per cent are working, 70 per cent of the carpenters and 50 per cent of the hoisting engineers. Structural iron workers have even greater difficulty in obtaining employment. In Minneapolis about 20 per cent of the skilled labor in the building trades are unemployed. Plasterers, however, find plenty of work. Most unemployment is among the unskilled.

Although the regular union scale for carpenters is 80c. in Baltimore, most of the work is being done by non-union carpenters at 50c. per hour. Pipe coverers are on strike because of a 20c. reduction, to 80c.

New Orleans reports continued increases in the volume of residential construction; but no industrial building is being undertaken there.

S means scarce; E, enough; P, plentiful—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90P	$0.70P	$1.00P	$0.30P	.....	$1.00P	$0.20P
Baltimore	1.25P	.80P	.87½P	.54P	$0.74P	1.00P	.30P
Birmingham	1.00P	.75P	.....	.25	.....	1.00P	15@.25
Boston	.90P	.90P	.90P	.60P	.90P	.90P	.55P
Cincinnati	1.25P	1.00P	.70E	.85P	1.00E	1.25P	.35@.40
Chicago	−1.10P	−1.00P	−1.10P	.....	.....	−1.05P	−.72½P
Cleveland	1.04P	1.04	1.04P	.60P	.91P	1.04	.57½P
Dallas	1.00P	1.00P	1.00E	.60E	1.00E	1.00E	.50@.75P
Denver	1.37½	1.00	1.00	.75@.81½	1.00	1.00	.37½@.50P
Detroit	1.00P	.80P	.80@.90P	.50@.60P	1.00P	.60@.80P	.50P
Kansas City	1.07½	1.00	1.07½P	.80	1.07½	1.07½	.70
Los Angeles	1.25P	1.00P	1.00P	1.12½P	1.00P	1.00P	50@.56¼P
Minneapolis	1.00P	.80P	.80P	.65P	.....	.80P	.50P
Montreal	−.85P	.60@.65P	.50@.55P	35@.40P	.50P	−.60P	.30@.35P
New Orleans	1.00P	.88P	.90P	.40P	.80P	1.00P	.30P
New York	1.25	1.12½	1.25	.87½	1.12½	1.12½	.75@.80
Pittsburgh	1.12½P	1.00P	1.00P	.80P	.....	1.00P	Open
St. Louis	1.25P	1.25P	1.25P	.85P	1.25P	1.25P	.67½P
San Francisco	1.25P	1.12½P	1.12½P	1.00P	1.12½P	1.12½P	.81¼P
Seattle	1.00P	.80P	.90P	.70P	1.00P	.80@.90P	.50@.60P

It is hoped that several thousand men may be employed on the roads of northern Minnesota during the winter in rock blasting and in distribution of materials for use by contractors next spring.

In St. Louis County alone during 1921 over 103 miles will have been paved by the end of the construction season and 680 miles will have been graded. About 440 miles of highways will have been graveled by the end of this year. In addition to that work the maintenance department has regraveled 462 miles of road and reshaped 713 miles.

The highway funds for trunk line construction for the current year are estimated at $13,500,000 exclusive of any Federal aid that may be voted, according to a recent statement made by the chief engineer of the state highway commission recently. The motor vehicle tax revenue exceeds $5,500,000 and approximately $7,500,000 of the proceeds from county reimbursement funds are being used for road improvements.

The New Jersey State Highway Commission will ask Congress to double its appropriation for highways so as to lessen the cases of unemployment during the coming winter. The highway commission has requested every man and woman in the state to ask the New Jersey senators at Washington to give their support for the double appropriation. Individuals are requested to write to the senators and congressmen and tell of the great number of unemployed cases. If Congress takes the action desired, New Jersey will receive as her share of the double allotment the sum of $2,420,000.

Southern Pine Orders Increase

For the week ended September 23, 141 mills reported to the Southern Pine Association orders received approximating 91,981,764 ft. b.m. Shipments for the week amounted to in excess of 89,000,000 ft. b.m. and production approximately 79,000,000 ft. b. m. This represents a production only 18½ per cent below normal. The shipments above production for the week were in excess of 10,000,000 ft. b.m. and the orders above production 13,000,000 ft. b.m. The orders on the books of southern pine mills at the end of the week ended September 23 amounted to about 280,000,000 ft. b.m.

Canadian Labor Down

According to the Montreal correspondent of *Engineering News-Record*, there have been several decreases recently wages paid the skilled trades and common labor in various parts of Canada. The Federal Department of Railways and Canals has recently put into effect a 20 per cent decrease in wages. The Ontario Hydro-Electric Commission has also put in force a decrease for all employees on the Chippawa development, the cut being 10 cents per hour. The building trades of Hamilton, Ontario, have consented to a decrease in the wages of carpenters from 85 cents to 75 cents per hour. Common labor, Prince Edward Island, in the building trades has been reduced from $2.70 to $2.25 per 9-hour day.

Railway Extension to Provide Work for Unemployed

Premier Drury has recently announced that the Ontario Government will proceed with the extension of the Timiskaming & Northern Ontario Ry. north from Cochrane to Smoky Falls, about 70 miles. One of the reasons why the extension is to be made is to provide employment for those now out of work. The district to be traversed by the railroad extension is well adapted for agricultural purposes, and the terminus of the extension offers large opportunity for the development of water power.

The estimated cost of the extension is about $3,500,000.

Chicago Labor Chiefs Indicted

Harry Jansen, president of the Chicago District Council, and Thomas S. Church, a business agent, have been indicted along with four other labor leaders by a special building grand jury in Chicago. The charges against the labor leaders are conspiracy. Bonds are fixed at $10,000 each. Previous indictments had been returned against three of the men named in this latter indictment.

Biltmore Hotel at Providence

The jurisdictional dispute which was reported to be holding up the construction of the Biltmore Country Club at Rye, N. Y., has not affected that work, as reported in *Engineering News-Record* last week. The trouble is being experienced on the new Biltmore Hotel at Providence, R. I.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Iron and Steel—While quotations as low as $1.60@$1.70 on structural shapes and plates have been reported, the official Pittsburgh base of $1.75 stands, except for very large orders. Bars are quoted at $1.65 per 100 lb. Mill prices of black steel sheets, base size, are quoted at $3 as against $2.75 and No. 10 blue annealed sheets at $2.50 as against $2.25 per 100 lb. Mill shipments, New York, of structural shapes and plates, are quoted at $1.98 @$2.03; bars at $1.88@$1.98 per 100 lb. Advances ranging from $1 to $2 per ton reported in pig-iron prices at various shipping points.

Pipe—New Pittsburgh basing card of Sept. 16 quotes increases in discounts ranging from 4 to 5 per cent on wrought steel pipe, which are reflected in warehouse quotations. Cast-iron pipe advances $2 in New York and Chicago; drops $2 in Birmingham and $3 per ton in St. Louis. Sewer pipe advances in St. Louis and declines slightly in Cincinnati and Baltimore.

Road and Paving Materials—Decreases ranging from $1 to $3 per ton in asphalt reported in Baltimore, Cincinnati and Atlanta. Paving stone and wood-blocks down in Kansas City, St. Louis, Cincinnati and Baltimore. Flagging advances 29c. in Chicago, present price 99c. as against 70c. per lin.ft.

Sand Gravel and Crushed Stone—Gravel down 5c. to 25c. per cu.yd. in New York, Chicago, Atlanta, Cincinnati and Montreal. Sand drops 5c. in Chicago and advances 6½c. per cu.yd. in Cincinnati. Crushed stone drops 10c. in New York and 25c. in Chicago; slight advances in Cincinnati and St. Louis.

Lime and Cement—Decreases ranging from $1.80 to $2 in hydrated finishing lime quoted in New York, St. Louis, Detroit and Montreal. Declines of from 50c. to $1 per ton in common hydrated lime in St. Louis and Detroit. Common lump lime down in Chicago, Minneapolis and Detroit, up 10c. per bbl. in Atlanta. General decline of 10c. to 25c. per bbl. in cement throughout principal cities. Minneapolis dealers quote cement at $2.45 delivered and $2.31 per bbl. on cars. However, we list $2.26 as the price f.o.b. Minneapolis, because cement can be bought direct from the manufacturer at that figure.

Structural Material—Slight reductions reported in triangle mesh in New York warehouses and rather heavy decreases in expanded metal lath in St. Louis.

Brick and Hollow Tile—Common brick advances $1 wholesale in New York and drops from $1 to $2 per 1,000 in Cincinnati, Kansas City and Montreal. Slight decline in hollow tile in St. Louis.

Lumber—Long leaf yellow pine advances $2 to $8 in Baltimore, Montreal and New Orleans and drops 50c. per M ft. in Kansas City and Atlanta. Douglas fir advances $1 to $3 in Seattle; both fir and hemlock drop $4 to $6 in Los Angeles and fir is down 50c. per M ft. in Kansas City.

Manila Rope—Advances of 1c. per lb. reported in New York, Minneapolis and Atlanta.

Explosives—Reduction of ½c. per lb. on 40% and 60% gelatin dynamite quoted in Cincinnati, Minneapolis and Denver; slight advances in Atlanta and Montreal.

Scrap—Advances ranging from $2.50 to $4.50 per net ton, reported in St. Louis. New York quotes rises of 50c. to $1.50 per gross ton.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$24.50†	$45.60
Northern Basic	22.52†	51.30
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	23.52†	48.50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	30.26†	52.10
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	20.00†	42.00@45.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	22.76†	51.25*
Virginia No. 2 (silicon 2.25 @ 2.75)	28.74†	50.00†
Basic	20.75†	51.00*
Grey Forge	*21.75*†	49.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	22.70†	46.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	26.66†	50.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	22.96†	49.56
Basic	23.96†	48.96
Bessemer	21.96†	51.96

*F.o.b. furnace. † Del'vered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$45.00	$55.00	$47.00	$45.00
Standard openhearth rails	47.00	57.00	*44.65*	47.00
Light rails, 8 to 10 lb.	45.00	2.88@3.50*	*1.75*	2.45@3.00*
Light rails, 12 to 14 lb.	45.00	2.84@3.34*	*1.75**	2.41@2.95*
Light rails, 25 to 45 lb.	40.00	2.75@3.25*	*1.75**	2.32@2.85*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In by 8 Ft. 6 In.
Chicago, White Oak	$1.35	$1.40
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago, Empty Cell Creosoting (add'l)	.45	.50
San Francisco, Green Douglas Fir	.80	1.12
San Francisco, Empty Cell Creosoted, Douglas Fir	1.76	2.48

For ties on standard "railroad administration" specifications, f.o.b. cars, St. Louis:

	White Oak	Red Oak	Pine and Sap Cypress
Grade 3	*$1.15*	$1.05	**$0.95**
Grade 2	*1.05*	*.95*	*.85*
Grade 1	*.95*	*.85*	**.75**

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.00	$4.00@4.25	$3.00	*$3.60*	*$5.10*	4.05
Track bolts	4.00	6.00@6.50	*4.00*	*4.60*	*6.10*	4.15
Standard section angle bars	2.75	3.00@4.00	2.75	3.25	*4.00*	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of Sept. 16, 1921:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	*68½*	*56*	¼ to 1¼	39½	24½

LAP WELD

2	*61½*	*49*	⅜	34½	20½
2½ to 6	*65½*	*53*	2½ to 6	37½	24½
7 to 8	*62½*	*49*	7 to 12	35½	22½
9 to 12	*61½*	*48*			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	*66½*	*55*	1 to 1½	39½	25½
2 to 3	*67½*	*56*			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	*59½*	*48*	2	35½	22½
2½ to 4	*63½*	*52*	2½ to 4	38½	26½
4½ to 6	*62½*	*51*	4½ to 6	37½	25½
7 to 8	*58½*	*47*	7 to 8	30½	18½
9 to 12	*52½*	*39*	9 to 12	25½	13½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	60%	*68½%*	*56½%*
3½ to 6 in. lap welded	51%	*65½%*	*53½%*

	New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	46%	*56%*	*42½%*
3½ to 6 in. lap welded	37%	*53%*	*39½%*

Malleable fittings, Class B and C, from New York stock sell at list less 5%. Cast iron, standard sizes, 32½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	**$50.30**	$86.20	*$38.00*	**$47.10@49.10**	*$46.20*	*$53.00*
6 in. and over	**45.30**	81.20	*35.00*	**44.10@46.10**	*43.20*	*50.00*

Gas pipe and Class "A," $3 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$42.50	$35.00	$50.00		$55.00
4	50.00	60.00	85.00	60.00	$90.00	65.00
5	80.00	85.00	140.00	80.00	115.00	84.00
6	105.00	110.00	140.00	100.00	150.00	110.00
8	175.00	175.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	*$0.14*			**.1175**	$0.135	*$0.12*	
4	.14		$0.09	**.1175**	.135	*.15*	$0.18
5	.21			**.1645**	.2025	*.18*	.165
6	.21		.135	**.1645**	.2025	*.21*	.25
8	.35		.225	**.235**	.315	*.30*	.35
10	.52			**.329**	.4725	*.42*	
12	.67		.3825	**.423**	.6075	*.54*	.80
15	1.15		.5625	**.73**	.81	*.90*	
18	1.55		.765	**1.029**	1.125	*1.32*	
20	1.98		1.125	**1.372**	1.35		
22	2.64				1.80		
24	2.97		1.4625	**1.764**	2.025	*2.16*	2.40
27	4.50			**2.75**	3.75	*3.00*	
30	5.00		4.00	**3.40**	4.75	*3.60*	
33	6.55			**4.05**	5.50		
36	7.50			**4.45**	6.00		

	3	5	8	12	24	36
Boston	*$0.108*	*$0.162*	*$0.252*	*$0.486*	*$1.62*	**$4.92**
Minneapolis			40	77	2.55	5.66
Denver		15	30	50	1.95	
Seattle	.145		36	72	2.59	
Los Angeles	.11*	.165*	.275	485	1.65	
New Orleans		.108	.27	.459	1.755	
Cincinnati	*.10*	*.15*	*.233*	*.45*	*1.50*	*4.305*
Atlanta	.098*	.147*	.245	.4165	1.5925	
Montreal, *delivered*	.30*	.45*	.85*	1.35	4.50	6.50
Detroit	.105	.1575	.245	.4725	2.115	5.4325
Baltimore (*f.o.b.*)	*.1225*	*.2275*	*.35*	.6885	*2.28*	*5.20*
Baltimore, *delivered*						

*4-in., 6-in., 9-in., respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05	**$0.13**
New York, 65% asphalt	(at terminal)	.05	.12
New York, binder	(at terminal)	.06	.13
New York, flux	(at terminal)	.05½	.13
New York, liquid asphalt	(at terminal)	.06½	.13
St. Louis, 50-60% asphalt (*f.o.b.*) *Tulsa, Okla.*		*.015**	.12
Chicago, 40-50% asphalt		.05	**.10½**
Chicago, 60-70% asphalt		.05½	**.11½**
Dallas, 40-50% asphalt		.10	**.08**
Dallas, 60-70% asphalt		.13	.10
Dallas, 75-90% asphalt		.15	.12
San Francisco, binder, per ton		15.00	13.00

* Freight $21.75 per ton to Whiting, Ind.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums, and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$24.00	$15.00
Boston	No quotations	
Chicago	*24.50*	*17.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	21.50*	15.00*
Dallas	35.00	27.00
Seattle	27.50	21.50
Denver	45.00	65.00
Minneapolis	....	20.50
St. Louis	sold out for 1921	
Baltimore	*28.00*	....
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	*30.00*	....
Detroit (petroleum asphalt)	24.50	20.00
Cincinnati	*24.49*	*19.49*
Maurer, N. J. (asphalt)	27@38	....
Maurer, N. J. (asphalt cement)	29@36	25@31

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00 per M
Chicago	About 4x8x4 dressed	3.35 sq.yd.
	About 4x8x4 common	3.00 sq.yd.
San Francisco	Basalt block 4x7x8	65.00 per M
Boston	5-in. granite	125.00 per M
Atlanta	Granite	2.00 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	107.00 per M
Baltimore	Granite	2.15 sq.yd.
Montreal	Granite	130.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	*4.30* sq.yd.
St. Louis	4x8x4 dressed	*3.25* sq.yd.
	4x84x common	3.00 sq.yd.
Kansas City	No. 1 Granite	*3.90@3.95* sq.yd.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	26	sq.ft.
	Queens, 5 ft.	26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft
Chicago	18 in. wide	99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.09
New York	3	16	2.17
New York	4	16	2.37
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	3.25
St. Louis	4	16	3.75
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	2.30
New Orleans	3	16	2.00
New Orleans	3½	16	2.35
New Orleans	4	16	2.65
Dallas	4	18	3.90
Baltimore	3½	16	*3.60*
Montreal, *delivered*	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	*2.35*
Kansas City	4	16	2.00@2.25

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.00	$3.00	$2.00	$3.00	$1.25	$1.50
Denver	2.00	2.00	1.80	1.80	1.60	1.00
Chicago	*1.75*	2.75	*1.75*	2.75	*1.75*	2.75
St. Louis, *per ton*	1.35	1.60‡	1.40	1.65	1.40*	1.65
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas, *delivered*	3.09	2.50	3.50	2.50	2.50	2.00
Minneapolis, *at pit*	2.00	2.25	....	....	1.00	0.75
Cincinnati	*2.17½*	....	2.36½	1.50	1.75½	1.45
San Francisco	2.25	1.50	2.50	1.50	1.50	1.50
Boston, per ton	2.65	3.50	2.65	3.00	2.00	2.75
New Orleans	2.85	3.60	....	....	1.35	1.85
Los Angeles, per ton	1.35†	1.25	*1.35*†	1.25	1.20†	1.15
Atlanta, per ton	*2.13*	....	*2.13*	....	1.35	2.75
Detroit	2.00	2.25	2.00	2.25	2.00	2.00
Baltimore, per ton	1.40	1.40	1.60	1.60	2.40	.70
Montreal, per ton	*1.25*	1.45	*1.25*	....	1.25	1.30
Birmingham, per ton	....	....	....	....	1.37	1.25‡

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 70c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.80@1.90	$1.90@2.00	$1.80@1.90	$2.15
Chicago	*1.75*	2.75	*1.75*	2.75
St. Louis *delivered*	1.65*	2.00	1.65	2.00
Dallas	2.80	3.50	2.80	3.50
San Francisco	2.25	1.50	2.50	1.50
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *at plant*	2.00	2.25	2.25	2.50
Kansas City†	1.50	2.35	1.50	2.35
Denver	....	....	....	....
Seattle *delivered*	3.00	3.50 (del.)	*3.00*	3.50 (del.)
Atlanta	2.25*	....	2.25*	....
Cincinnati *delivered*	2.68½	....	2.06½	1.65
Los Angeles	1.60*	1.60*	1.70*	1.70*
Detroit	1.90*	1.75	1.90*	1.75*
Baltimore	1.75*	1.80*	1.65*	2.20*
Montreal	2.00*	2.35*	2.10*	2.80*
Birmingham *delivered*	3.20	....	3.10	....

*Per ton. †F.o.b. Joplin, Mo.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Lebanon or Bethlehem, Pa.	$1.00	$1.00	$2.50	$0.90
Easton or Catasaqua, Pa.	1.00	1.00	2.00	.90
Buffalo, N. Y. and Erie, Pa.	1.25	1.25	2.25	1.25
Emporium, Pa	1.25	1.25	....	1.25
East Canaan, Conn.	1.25	1.35	4.00	1.10
Birmingham, Ala.	.90	1.15	2.05	.80
Toledo, Ohio	1.50	1.50	2.35	....
Atlanta, Ga.	....	2.10	....	....
Easter Pennsylvania and Ne Jersey	1.20	1.20	2.50	.90
Westrn Pennsylvania and New Jersey	1.25	1.25	2.50	1.25

Birmingham, f.o.b. sidings $1.12 (or $1.45 per cu. yd. on site)

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per 180-Lb. Barrel (net) Finishing	Lump, per 180-Lb. Barrel (net) Common
New York	$16.99	....	....	$3.69*
Chicago	*18.00*	....	....	1.40
St. Louis	*22.20*	*$19.00*	$2.25	
Boston	*23.00*	*20.00*	*3.35*	3.10
Dallas	25.00	....	....	2.75
Cincinnati	*0.49*	*0.45*	....	
San Francisco	25.40	22.00	....	*1.90*
Minneapolis	29.00	22.00 (white)	1.80	*1.40*
Denver	30.00	2.95 (bbl.)	.95†	
Detroit	*15.25*	*13.25*	*11.50*‡	10.50‡
Seattle	27.50	....	3.50	3.25
Los Angeles	....	30.00	3.00*	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	*26.00*	....	15.00‡	
Atlanta	19.00	16.00	2.00	1.60
New Orleans	....	17.25	....	1.75

* 280-lb. barrels (net). † Per bushel. ‡ Per ton.

Minneapolis quotes common lump lime Kelly Is. white; brown is $1.50.

Cincinnati quotes hydrated lime per 50-lb. sack.

NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$3.00
Kansas City (Ft. Scott)	1.60	1.60
New Orleans	3.16	3.30
Atlanta (Magnolia)	11.00 ton	1.90
Cincinnati (Utica)	*1.77*	2.85
Boston (Rosendale)	1.05@1.95	2.35

PORTLAND CEMENT—Current prices are for barrels in carload lots, *without* bags, to contractors:

	Current	One Month Ago Without Bags	One Year Ago Without Bags
New York (delivered)	$2.50	$2.60@2.70	$4.10
New York, alongside dock to dealers	*2.10*	2.40	
Jersey City (delivered)	*2.60*	2.89	4.39
Boston	*2.61*	2.86	3.32
Chicago	*1.97*	2.17	2.35
Pittsburgh	*2.02*	2.17	2.42
Cleveland	*2.28*	2.43	2.73
Detroit	*2.31*	2.43	2.71
Indianapolis	*2.23*	2.43	2.57
Toledo	*2.31*	2.49	2.71
Milwaukee	*2.19*	2.39	2.59
Duluth	*1.95*	2.10	2.35
Peoria	*2.25*	2.45	2.63
Cedar Rapids	*2.31*	2.51	2.71
Davenport	*2.27*	2.47	2.67
St. Louis	2.90	2.90	3.00
San Francisco	*2.84*	3.09	3.09
New Orleans	3.20	3.20	5.00
Minneapolis (delivered)	*2.45*	2.60 (del.)	3.42
Denver	3.10	3.10	3.25
Seattle	3.10	3.10	3.12
Dallas	*2.55*	2.80	2.92
Atlanta	*2.69*	2.75	4.90
Cincinnati	*2.37*	*2.57*	2.85
Los Angeles	3.31	3.31	3.10
Baltimore (del.) drayload lots	*2.88*	2.98 (del.)	3.59 (del.)
Detroit	*2.31*	2.43	3.50
Birmingham	2.85	*2.85*	....
Kansas City	*2.80*	*3.05*	2.76
Montreal	2.75	2.75	2.95

NOTE—Bags 10c. each, 40c. per bbl.; 80c. per bbl. in Montreal; 60c. per bbl. in Los Angeles.

Current mill-prices per barrel in carload lots, without bags:

Buffington, Ind	$1.70
Pittsburgh, Pa	1.75
Steelton, Minn	1.75
Northampton, N. Y	1.75
Hudson, N. Y	1.85
Vulcanite, N. J	1.75

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds	Pittsburgh, Mill	New York (Warehouse)	Chicago	Dallas	San Francisco
032	0.022	$0.74	1.13	$0.82	$1.15	$1.24
049	0.028	.94	1.40	1.05	1.46	1.56
068	0.035	1.14	1.67	1.27	1.80	1.92
093	0.045	1.46	2.11	1.63	2.30	2.46
126	0.057	1.80	2.58	2.02	2.86	3.07
153	0.068	2.14	3.05	2.40	3.40	.....
180	0.078	2.46	3.48	2.76	3.93	.....
245	0.103	3.24	4.55	3.63	5.15	.....
287	0.119	3.75	5.25	4.20	5.96	6.41
336	0.138	4.35	6.07	4.87	7.32	.....
395	0.160	5.04	7.01	5.65	8.00	.....
			PAVING			
036P	0.017	$0.56	$0.88	0.62	$0.88	.....
053P	0.024	.79	1.20	0.88	1.24	.....
072P	0.031	.99	1.48	1.11	1.57	.....
097P	0.040	1.28	1.87	1.43	2.02	.....
049R	0.024	.79	1.20	.....	1.24	.....
067R	0.031	.99	1.48	.....	1.57	.....
084R	0.040	1.28	1.87	.....	2.02	.....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27	233	$23.25	$23.39	$23.39	$27.62	$25.50
26	250	24.65	24.93	22.54	26.87	27.56
25	300	27.30	27.45	27.45	.....	30.71
24	340	29.10	29.33	29.33	30.90	33.16
22	433	33.80	34.06	26.60	.....	35.10

* Material shipped from mill, freight allowed, or at warehouse. Delivery charge is 1c. per sq.yd.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$1.65	$1.90	$2.78	$2.78	$2.87	$3.50	$2.35
⅜ and larger	1.70	2.25	2.83	2.82	2.92½	3.55	2.40
½ and larger	1.75	2.25	2.88	2.88	2.97½	3.60	2.45
⅝ and larger	1.90	2.25	2.93	3.03	3.12½	3.75	2.60
¾ and larger	2.15	2.25	2.98	3.48	3.37½	4.00	2.85

* Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ and larger	$1.90	$1.90	$3.25	¼	$2.30	$2.15	$3.50
⅜ in.	1.95	1.95	3.30	½	2.30	2.40	3.75
½	2.00	2.00	3.35	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$18.40@19.40	$18.40	$22.70	$47.00	$42.50
New York (at dock)	15@15.50	15@15.50	.....	.....	.....
Chicago	11.00	11.00	15.00	34.00	42.50
St. Louis, salmon	17.00	17.00	17.00	.....	.....
Denver, salmon	14.00	14.00	15.00	.....	.....
Dallas	12.72	12.72	22.07	44.00	.....
San Francisco	18.00	18.00	18.00	.....	44.38
Los Angeles	15.50	15.50	13.50	(not used)	
Boston (del.)	17.00	17.00	30.00	46.00	56.25
Minneapolis (del.)	17.00	17.00	24@26	37.00	43.00
Kansas City	14.50	15.50	22.00	.....	.....
Seattle	14.00	14.00	19.00	48.00	53.50
Cincinnati	18.50	19.00	24.00	41.00	.....
Montreal (del.)	16.00	18.00	20.00	100.00	120.00
Detroit (del.)	17.00	17.00	22.00	41.30	44.00
Baltimore (del.)	20.00	20.00	20@25	38.00‡	.....
Atlanta	10.00	10.00	24.00	40.00	.....
New Orleans	14.00	14.00	25.50	.....	.....
Birmingham	11.50	11.50	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots for hollow building tile:

	New York: Current on Trucks*	New York: One Year Ago	Chicago	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.11370	$0.2444	$0.0926	$0.080	$0.145	.....
6x12x12	.15160	.3259	.1343	.115	.12	.....
8x12x12	.20210	.4345	.1575	.150	.29	$0.17810
10x12x12	.....	.....	.1853	.200	.....	.22260
12x12x12	.....	.....	.2408	.230	.....	.26720

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.097	$0.185	$0.260
Minneapolis (f.o.b. cars)	.084	.161	.230
Minneapolis (delivered)	.092	.175	.250
Cincinnati	.0682	.128	.175
Kansas City	.100	.175	.225
Denver	.09	.16	.23
Seattle	.10	.175	.30
Los Angeles factory	.103	.185	.22*
New Orleans	.14	.25	.42
Detroit (delivered)	.070	.135	.225
Montreal	.20	.30	.35
Baltimore	.16	.26	.42
Atlanta	.0765	.136	.....
Dallas	.124	.....	.....
Birmingham	.095	.1785	.....

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York (del.)	Dallas	St. Louis	Chicago (del.)	San Francisco
Beams, 3 to 15 in.	1.75	$2.00	$2.88	$4.00	$2.97½	$2.88	$3.85
Channel, 3 to 15 in.	1.75	2.00	2.88	4.00	2.97½	2.88	3.85
Angles, 3 to 6 in., ¼ in. thick	1.75	2.00	2.88	4.00	2.97½	2.88	3.85
Tees, 3 in. and larger	1.75	2.00	2.88	4.00	2.97½	2.88	3.85
Plates	1.75	2.00	2.88	4.00	2.97½	2.88	3.85

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Warehouse: Chicago	Warehouse: St. Louis	Warehouse: San Francisco	Dallas
½ in. and larger	$2.65	$4.40	$6.00	$3.68	$3.77½	$5.50	$5.50

CONE HEAD BOILER

½ in. and larger	2.75	4.50	7.10	3.78	3.87½	5.60	5.65
⅝ and ¾	2.90	4.65	7.25	3.93	3.87½	5.75	5.80
⅞ and 1	3.15	4.90	7.50	4.28	3.87½	6.00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.75@$3.00	$3.50	$4.90	$5.00	$3.48	$4.95
Cut	3.00@3.25	6.10	6.25	7.75	4.08	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2.12	$2.48	$2.90	$2.02	$2.38	$2.80
No. 2 grade	1.87	2.18	2.55	1.77	2.08	1.67

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.15 per roll in carload lots and $2.40 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $6.15 per square in carloads; $6.40 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft	$2.35
Tar pitch (in 400-lb. bbl.), per 100 lb	1.85
Asphalt roofing (in barrles), per ton	47.50
Asphalt felt (light), per ton	77.00
Asphalt felt (heavy), per ton	78.50

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.50	$2.87½	$3.38	$5.50	$3.28
No. 12	2.60	2.92½	3.43	5.55	3.33
No. 14	2.70	3.97½	3.48	5.60	3.38
No. 16	2.80	3.07½	3.58	5.70	3.48
Black					
*Nos. 18 and 20	2.85	3.95	3.95	5.80	3.80
*Nos. 22 and 24	2.90	4.00	4.00	5.85	3.85
*No. 26	2.95	4.05	4.05	5.90	3.90
*No. 28	3.00	4.15	4.15	6.00	4.00
Galvanized					
No. 10	3.00	4.15	4.15	.....	4.00
No. 12	3.10	4.25	4.25	5.85	4.10
No. 14	3.10	4.25	4.25	5.85	4.10
Nos. 17 to 21	3.40	4.55	4.55	6.15	4.40
Nos. 22 and 24	3.55	4.70	4.70	6.30	4.55
*Nos. 25 and 26	3.70	4.85	4.85	6.45	4.70
*No. 28	4.00	5.15	5.15	6.75	5.00

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl.)	$0.76	$1.25	$0.87	$1.40

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	12 25	13 75	15 50	17 00	12 25	15 50
25 and 50-lb. kegs	12 50	14 00	15 75	17 25	12 50	15 75
12½-lb. keg	12 75	14 25	16 00	17 50	12 75	16 00
5-lb. cans	15 25	16 75	18 50	20 00	15 25	18 50
1-lb. cans	17 25	18 75	20 50	22 00	17 25	20 50

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco			
	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$25 00	$28 00	$31 00	$33 00
3x6 and 8	25 00	28 00	29 00	31 00
4x4-6 and 8	27 00	30 00	31 00	33 00
3x10 and 12	27 00	29 00	31 00	33 00
3x14	28 00	30 00	32 00	34 00
4x10 and 12	29 00	31 00	33 00	35 00
4x14	30 00	32 00	34 00	36 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
†10	$30 00	$32 00	$34 00
6x14	32 00	34 00	36 00
8x10	30 00	32 00	34 00
3x14	32 00	34 00	36 00

New York, Chicago and St. Louis

	Southern Pine			
	New York*		Chicago	
	20 Ft. and Under	20–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$35 00	$36 00	$41 00	$42 00
3x10 to 10x10	37 00	38 00	43 00	44 00
3x12 to 12x12	40 00	41 00	46 00	47 00
3x14 to 14x14	45 00	46 00	49 00	50 00
3x16 to 16x16	50 00	51 00	59 00	60 00
3x18 to 18x18	55 00	56 00	64 00	65 00
4x20 to 20x20	65 00	66 00	66 00	67 00

* Wholesale price (to dealers) of long leaf pine. Short leaf pine up to 14 x 14 costs $15 per M. less.

Price to contractors, on lighters or cars, New York, about $5 additional.

St. Louis: Yellow pine, 22@ 24 ft. long, 3 x 4 to 4 x 4, $34.50; 3 x 6 to 8 x 8, $33; 3 x 12 to 5 x 12, $40; 3 x 14 to 4 x 14, $46; 3 x 16 to 4 x 16, $51; 3 x 18 to 5 x 18, $58.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$47 00	$52 00	$55.00	$48 00	$57 00	$52 00
Seattle		22 00				22 00
New Orleans	28 00	23 50			33 09	27 00
Baltimore	30 00				32 50	
Cincinnati	38 00	50 00			45 00	64 00
Montreal	78 00	85 00	68 00	78 00	78 00	100 00
Los Angeles		*41 00*	*40.00*			*41 00*
Detroit	Quotations f. o. b. mills only					
Denver		31 75				32 75
Minneapolis	42 00	36 00	33 00		49 00	36.00
Atlanta	*27 00*				39 00	
Dallas	31 00				35 00	
Kansas City	40 00	47 00	47 00		*44.50*	*44.50*
Birmingham	30 00				34 00	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47 00	$48 00	$37.00	$45 00	$48 00
Seattle		35 00			16 00
New Orleans, at mill	52 00	25 00		32 00	
Baltimore	34 00			32 50	
Cincinnati	62 50	80 00		33 50	
Montreal	120 00	60 00	60 00	80.00	80 00
Los Angeles		*32 00*	*33.00*		63 00
Denver		29 75			27 75
Minneapolis	38 00	31 25	30 25	37 00	29.25
Atlanta	15 00			18 00	
Dallas	32 00	30 00		34.00	
Kansas City	37 00	31 00		*36.00*	*36.00*
Birmingham	25 00†			23.00	

* Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—†1x12x16. $2 additional per M. ft. for delivery

Detroit—General quotations not available. Rough fir, 2 x 12 and 2 x 4, by 16 ft. $44; 3 x 12 x 16 ft., $48; 2 x 4 x 16, $42.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 33½	Detroit	$0 33
Birmingham	76½	Kansas City	81½
Boston	41½	New Orleans	51½
Buffalo	29½	New York	38
Chicago	38	Pacific Coast (all rail)	1 66½
Cincinnati	32½	Philadelphia	35
Cleveland	24	St. Louis	47½
Denver	1 35*	St. Paul	66½

Note—Add 3% transportation tax. * Minimum carload, 40000 lb.

Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2 00	$2.00	$4.00@$5 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York and East of Mississippi River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	55%
Patent flattened strand, iron rope	40%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Iron strand and iron tiller	10%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington: Galvanized iron rigging and guy ropes +12½%; bright plow 35% off.

Wyoming, New Mexico and Colorado: Plow steel, round strand, 35% off, galvanized iron rigging and guy rope +12½%.

Arizona: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Montana, Idaho and Utah: 30% plow steel; +17½% galvanized iron rigging and guy rope.

Western territory not included in above: Plow steel, 35%; galvanized iron rigging and guy rope +12½%.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0 19	New Orleans	$0 16
New York	17½	Los Angeles	14½
Chicago	18	Seattle	16
Minneapolis	18½	St. Louis	16½
San Francisco	15	Montreal	30
Atlanta	20	Detroit	175
Denver	18	Baltimore	22
Cincinnati	17	Kansas City	16
Dallas	29	Birmingham	20½

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	0 3075	$0 3425
Boston	.24	275
Kansas City	.24	275
Seattle	.1875	2125
Chicago	.2275	2525
Minneapolis	*2274*	*2530*
St. Louis	.28	315
Denver	*2350*	*2700*
Dallas	29	375
Los Angeles	25	27
Atlanta	2675	3025
Baltimore	2550	27
Cincinnati	*2275*	*2725*
Montreal	32	37
Birmingham, *delivered*	1925	2275
New Orleans	2725	3075

PILES—For plain pine piles, delivered New York, the price is as follows:

Pine 12-in. butts, 6-in. tops, length 41-50 ft.	$9.00@11 00
Pine 14-in. butts, 6-in. tops, length 51-60 ft.	18 50@15 50
Pine 14-in. butts, 6-in. tops, length 61-71 ft.	19 00@21 00

	Dallas		St. Louis
6-in. x 20-ft.	$4 60	6-in. x 30-ft.	$6 95
		7-in. x 30-ft.	*8 30*
6-in. x 30-ft.	7 10	7-in. x 35-ft.	*11 70*
		8-in. x 35-ft.	*13 90*
8-in. x 30-ft.	8 45	7-in. x 40-ft.	*13 90*
		8-in. x 45-ft.	*18 70*
8-in. x 35-ft.	10 38	8-in. x 50-ft.	*22 10*

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10 50	$11 50	$13 50
Stove plate	10 50	12 00	13 50
No. 1 machinery cast	16 50	13 50	16 00
Machine shop turnings	3 00	4 00	6 50
Cast borings	3 75	5 50	8 50
Railroad malleable cast	9 50	12 50	11 00
Re-rolling rails	11 50	13 00	12 00
Relaying rails	30 00	30 00	27 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco		Seattle
	Galv.	Black	Black
½	$9 10	$8 40	$8 55
⅝	8 65	6 65	8 25
¾	8 50	6.50	8 30

Pittsburgh base, *$3.25@$3.40* per 100 lb.